

Addendum to the

Exceptional Events Demonstration for  
2015 Ozone Exceedance in Washoe County from the  
2015 California Wildfires August 21, 2015

Submitted to U.S. EPA Region 9 March 17, 2017

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## ACRONYMS

AQI	Air Quality Index
AQMD	Washoe County Health District, Air Quality Management Division
AQS	Air Quality System
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO	Carbon Monoxide
EC	Elemental Carbon
EE	Exceptional Event
EER	Exceptional Events Rule
EPA	U.S. Environmental Protection Agency
°F	Degrees Fahrenheit
HA 87	Hydrographic Area 87
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
km	Kilometers
µg/m <sup>3</sup>	Micrograms per cubic meter
NAAQS	National Ambient Air Quality Standards
NCore	National Core Multi-Pollutant Monitoring Station
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Nitrogen Oxides
NWS	National Weather Service
OC	Organic Carbon
O <sub>3</sub>	Ozone
PST	Pacific Standard Time
PM	Particulate Matter
PM <sub>2.5</sub>	Particulate Matter less than or equal to 2.5 microns in aerodynamic diameter
PM <sub>10</sub>	Particulate Matter less than or equal to 10 microns in aerodynamic diameter
ppm	Parts Per Million
SLAMS	State and Local Air Monitoring Station
SO <sub>2</sub>	Sulfur Dioxide
TSP	Total Suspended Particles
UTC	Coordinated Universal Time
VMТ	Vehicle Miles Traveled
VOC	Volatile Organic Compounds

## **1.0 NARRATIVE CONCEPTUAL MODEL**

### **1.1 Regional Description**

Refer to the *Exceptional Events Demonstration for 2015 Ozone Exceedance in Washoe County from the 2015 California Wildfires August 21, 2015* (2015 EE Demonstration).

### **1.2 Overview of Ambient Air Monitoring Network**

Refer to the 2015 EE Demonstration

### **1.3 Characteristics of Non-Event Ozone Formation**

Refer to the 2015 EE Demonstration

## 2.0 EXCEPTIONAL EVENT SUMMARY

### 2.1 Exceptional Events Definition and Demonstration Criteria

Refer to the 2015 EE Demonstration

### 2.2 Statement of Purpose

In August 2015, smoke from numerous lightning caused wildfires in California, Oregon, and Washington was transported into the Reno/Sparks, Nevada area. This resulted in elevated ozone (O<sub>3</sub>) and fine particulate matter (PM<sub>2.5</sub>) concentrations on August 18-21, 2015. On June 3, 2016, the Washoe County Health District, Air Quality Management Division (AQMD) submitted an Initial Notification of Potential Exceptional Event Information Summary to the U.S. Environmental Protection Agency (EPA) Region 9 requesting exclusion of those data for comparison to National Ambient Air Quality Standards (NAAQS). EPA determined that the August 2015 event could have a regulatory impact, however, directed AQMD to proceed with an exceptional events demonstration for a single monitor (Reno3, AQS ID 32-031-0016), for a single parameter (O<sub>3</sub>), for a single day (August 21).

On November 10, 2016, AQMD submitted an *Exceptional Events Demonstration for 2015 Ozone Exceedance in Washoe County from the 2015 California Wildfires August 21, 2015* (2015 EE Demonstration) to EPA Region 9. Subsequently, EPA Region 9 requested an addendum to the 2015 EE Demonstration to include two additional days (August 18 and 19, 2015) for O<sub>3</sub> from the Reno3 monitor.

This addendum includes additional data and information demonstrating that the O<sub>3</sub> exceedances on August 18 and 19, 2015 were the result of smoke impacts from numerous wildfires throughout the Pacific Northwest. It also further supports the August 21, 2015 event documented in the 2015 EE Demonstration.

This addendum underwent 30-day public comment concurrent with EPA Region 9's review beginning March 17, 2017 pursuant to 40 CFR 50.14(c)(3)(v). By May 1, 2017, AQMD will forward any written comments received and provide documentation that the public comment process was followed.

### 2.3 Summary of Event

The 2015 fire season in California was above the 10-year average with 8,745 fires and 893,362 acres burned as reported by all agencies. The 10-year average is 7,971 fires with 673,446 acres burned. Of the 8,745 fires, 273 were greater than 10 acres. Additionally, the fire season in the Pacific Northwest was record-breaking.

On August 16, 2015, smoke from numerous wildfires throughout California, Oregon, and Washington began to impact the Reno/Sparks area. Smoke plume impacts continued to affect the Reno/Sparks area throughout August. Between August 18 and August 21, 2015, the AQMD monitored 9 exceedances of the 2015 8-hour O<sub>3</sub> NAAQS and 2 exceedances of the 24-hour

PM<sub>2.5</sub> NAAQS across its air quality monitoring network. The AQMD is requesting additional exclusion through this addendum of the 8-hour O<sub>3</sub> concentrations from Reno3 on August 18 and 19, 2015 due to the increase in PM<sub>2.5</sub> from wildfire smoke causing exceedances of the O<sub>3</sub> NAAQS.

The Reno/Sparks area was impacted from the California Complex Fires (Fork, Mad River, South, Route, River, and Gasquet) and Nickowitz Fire north of the Complex Fires (refer to the 2015 EE Demonstration for perimeter maps of the California Complex Fires), as well as several complex fires located throughout Oregon and Washington (Figures 2.1 and 2.2). The exceptional event days are summarized below.

Figure 2.1: Location of Large Fire Locations in Oregon 2015  
(Northwest Annual Fire Report 2015)

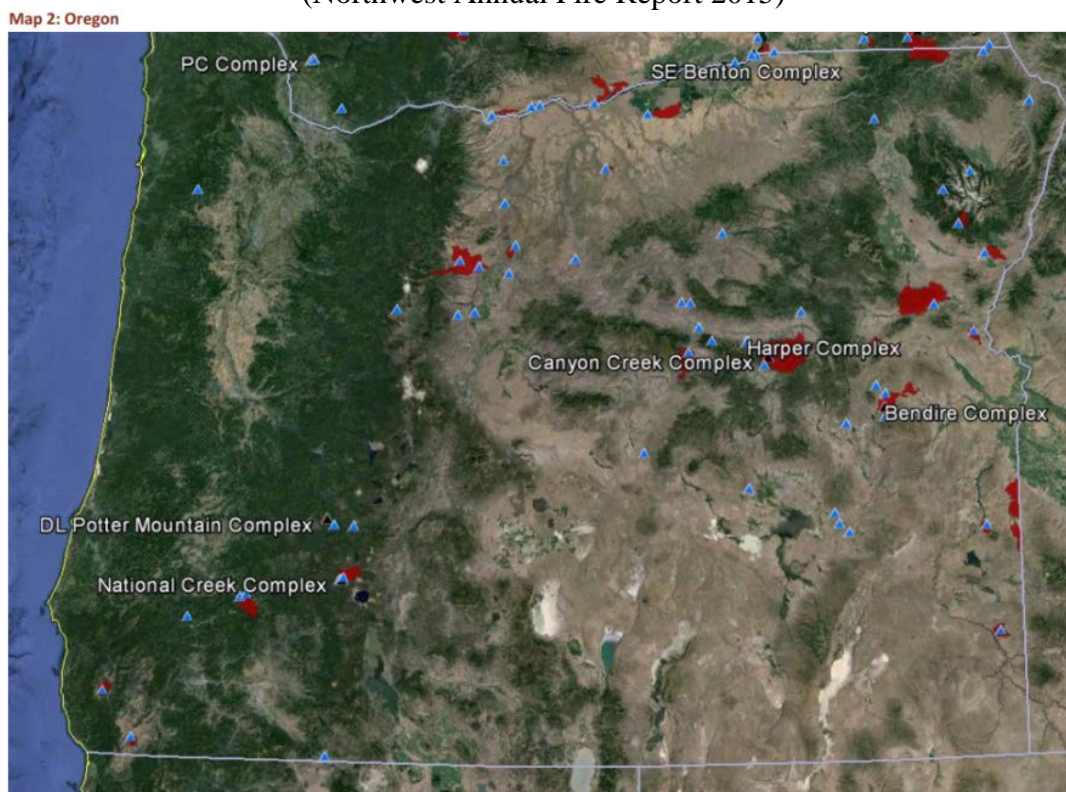
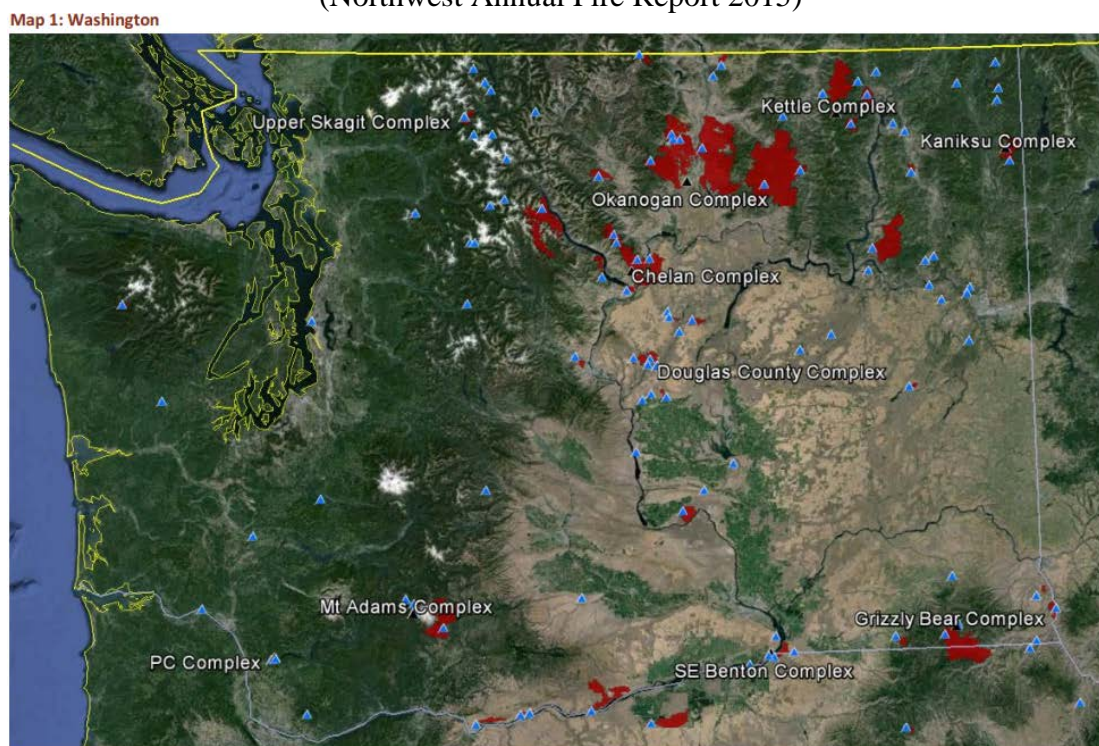


Figure 2.2: Location of Large Fire Locations in Washington 2015  
(Northwest Annual Fire Report 2015)



## Daily Event Summaries

The following sections and figures below show evidence that there was an exceptional event on August 17, 18, and 19, 2015, and the impacts from the event affected the Reno/Sparks area. Included below by event day is: 1) Current Wildland Fires map for California, 2) Worldview satellite image of visible smoke from the Pacific Northwest wildfires, 3) AirNow Tech images of the HMS smoke plume, detected fires, and O<sub>3</sub> concentrations, 4) HMS smoke plume maps, 5) Satellite Smoke Text Products<sup>1</sup>, and 6) media posts. Media posts were not readily available for August 16 and 17, 2015 as the heaviest wildfire smoke was still upwind of the Reno/Sparks area.

AQMD collaborated with the National Weather Service (NWS) and local media to provide timely notifications to the public throughout the exceptional event. Air Quality Index (AQI) forecasts and air alerts were distributed daily, or more frequently, via EnviroFlash and social media (Facebook, Twitter). AQMD leverages NWS and local media's tens of thousands of social media followers to share accurate and consistent information to the community. In addition, air quality information was available from the AQMD website (OurCleanAir.com) and Air Quality Hotline [(775) 785-4110].

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<sup>1</sup> These text products are produced by the National Oceanic and Atmospheric Administration and provide a narrative of the satellite imagery. Text products are updated twice per day. Current and historic text products are available at [www.ssd.noaa.gov/PS/FIRE/smoke.html](http://www.ssd.noaa.gov/PS/FIRE/smoke.html).

## August 16, 2015 Event Summary



Figure 2.3: Location of California Wildland Fires August 16, 2015

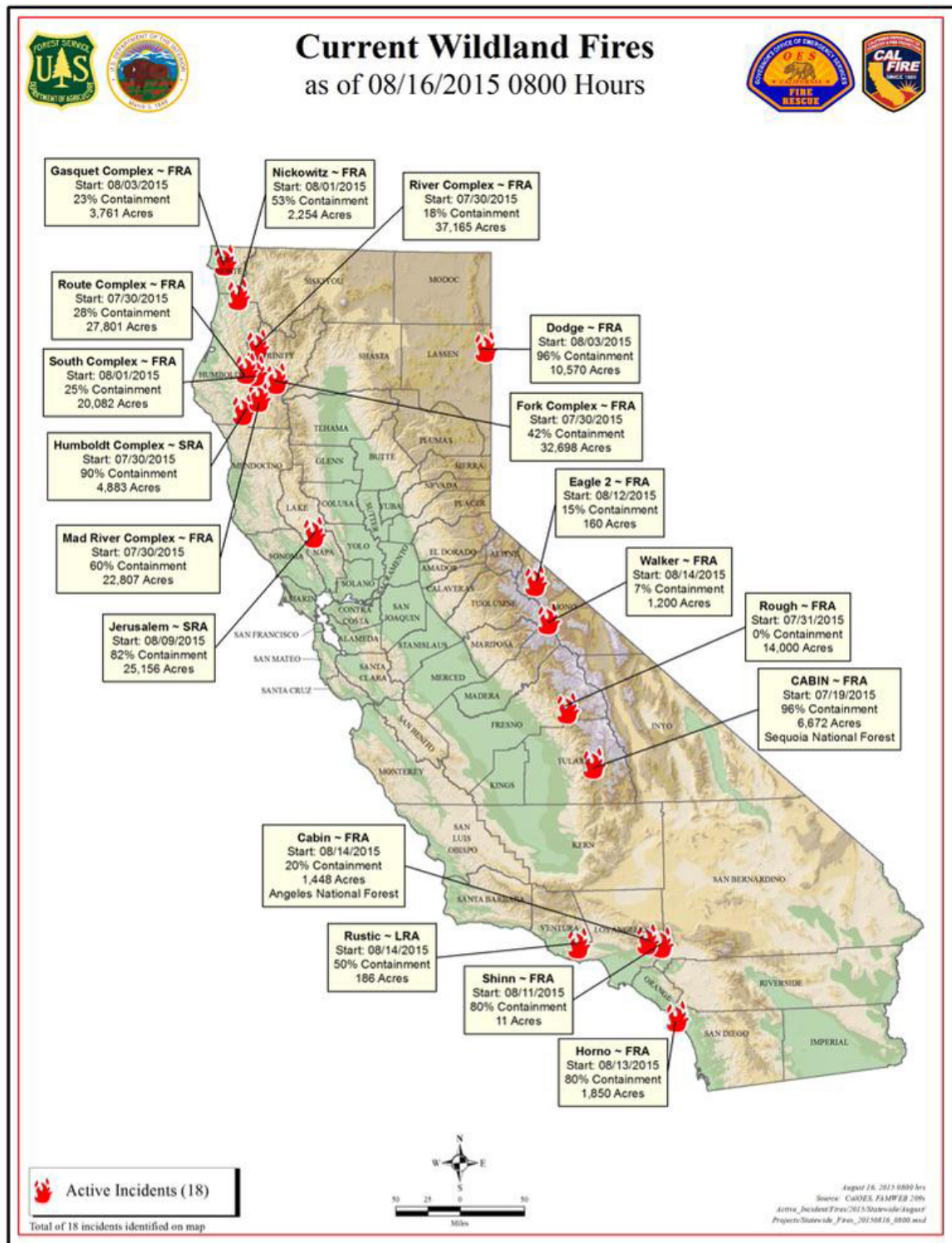


Figure 2.4: Satellite Image of the California and Pacific Northwest Wildfires August 16, 2015

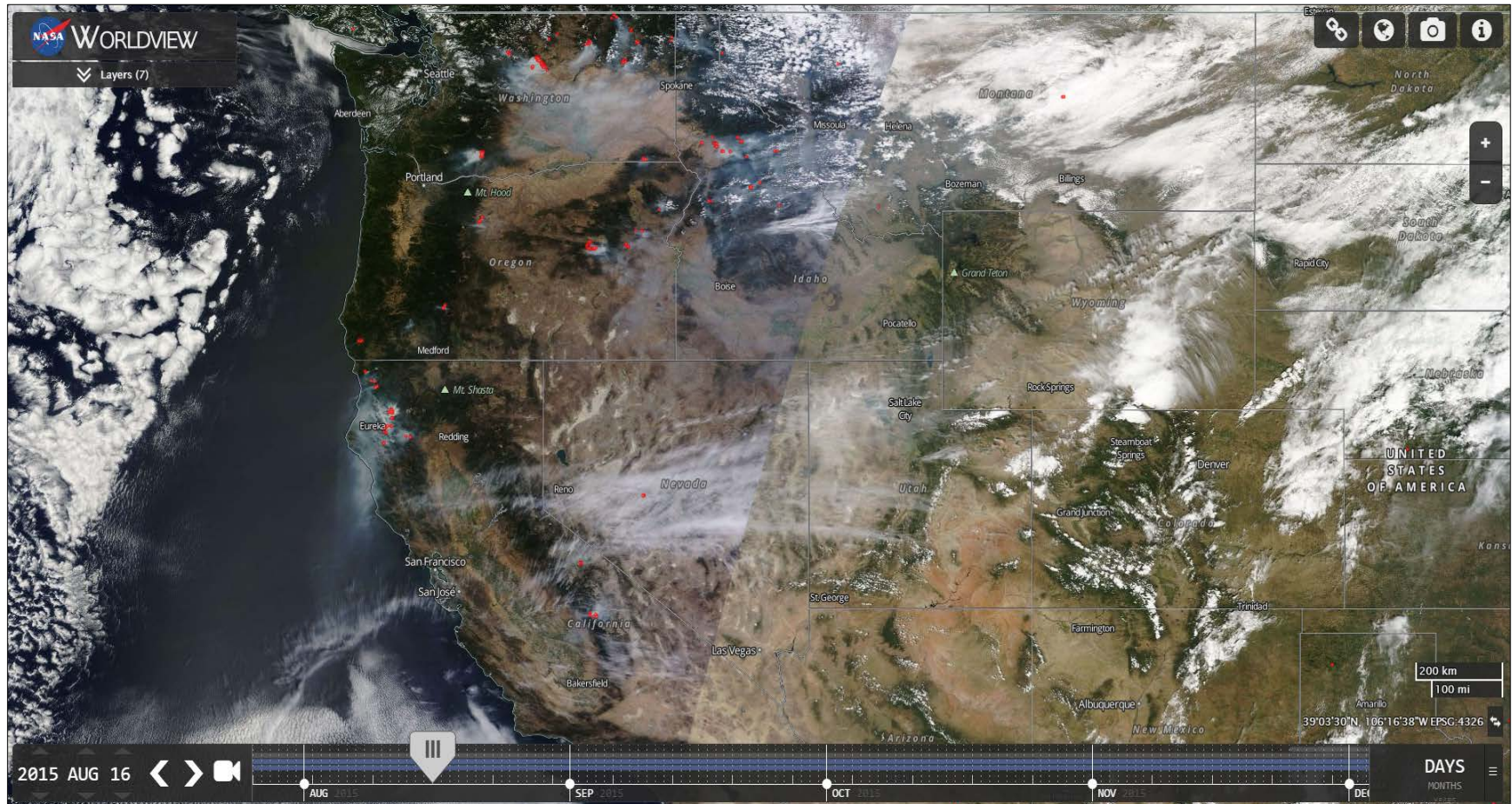




Figure 2.5: AirNow Tech Image of Active Fires, Smoke Plumes, and O<sub>3</sub> Concentrations throughout the Pacific Northwest  
August 16, 2015

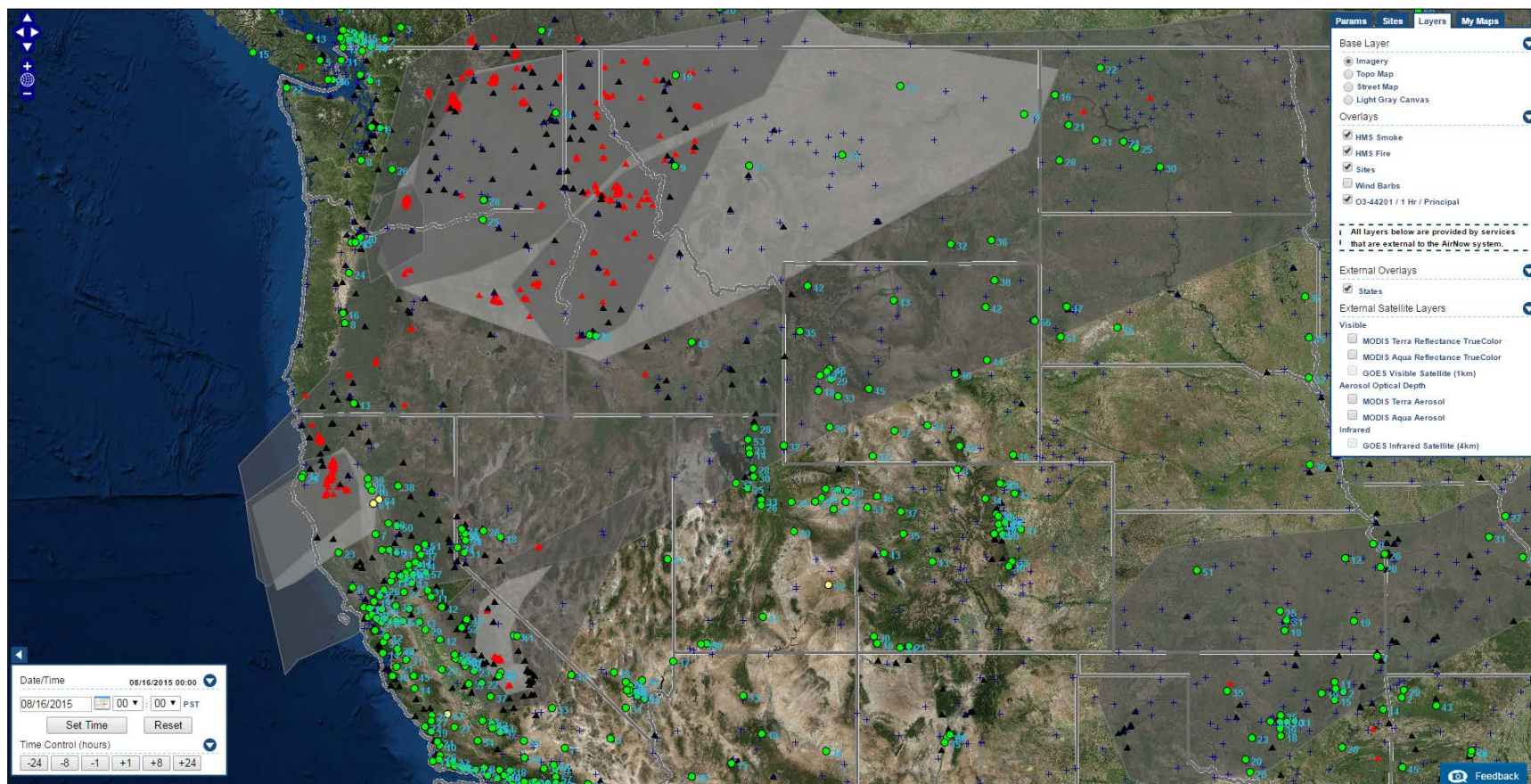


Figure 2.6: HMS Smoke Plume Map August 16, 2015

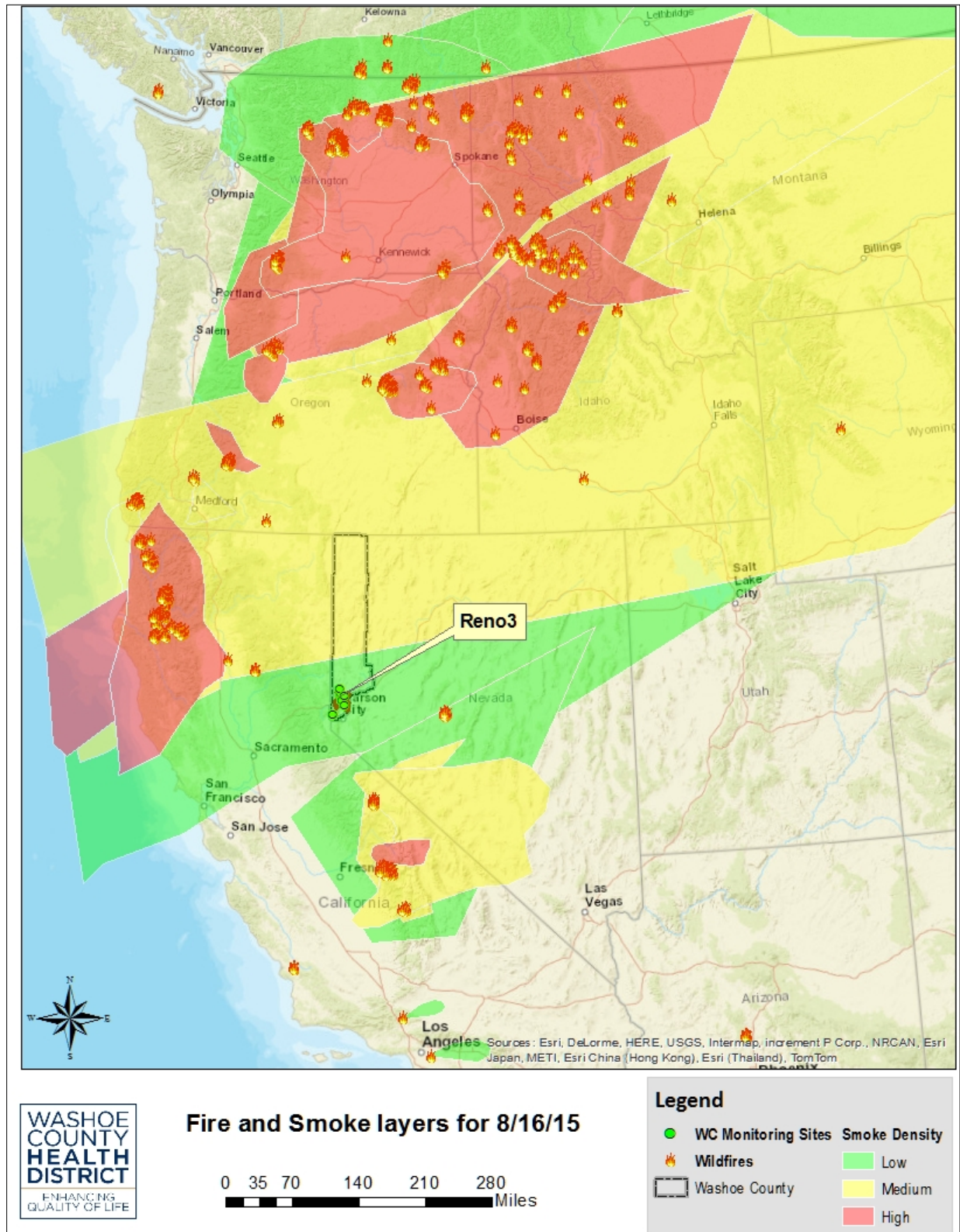




Figure 2.7: Satellite Smoke Text Product August 16, 2015

**Saturday, August 15, 2015**

**DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY THROUGH 0245Z August 16, 2015**

**SMOKE:**

**Northwestern/North Central US/South Central Canada:**

The large number of wildfires scattered across portions of the Northwestern US continued to emit tremendous quantities of smoke. The largest and most dense area of smoke of moderate to thick density was visible spreading to the east across portions of Washington, Oregon, and Idaho, across Montana and North Dakota. The thicker smoke also covered much of the southern half of Alberta, Saskatchewan, and Manitoba in southwestern Canada.

**Northern and Central California:**

Thick smoke from the cluster of fires in northern California moved primarily to the south and over west central California and offshore over the Pacific along the coast.

**East Central California/Western Nevada:**

Fires in the Sierras produced thick smoke plumes which moved to the northeast into western Nevada.

**Much of the US and Southern to Southeastern Canada:**

An extremely large surrounding mass of mainly thin density smoke was visible in between the thicker areas of smoke over the Western and Northwestern US and also over a large portion of the Central and South Central US as well as over the northern Great Lakes region. The thinner density smoke also covered much of southeastern Canada and was just beginning to enter the Northeastern US over northern NY state and northern New England.

JS

THIS TEXT PRODUCT IS PRIMARILY INTENDED TO DESCRIBE SIGNIFICANT AREAS OF SMOKE ASSOCIATED WITH ACTIVE FIRES AND SMOKE WHICH HAS BECOME DETACHED FROM THE FIRES AND DRIFTED SOME DISTANCE AWAY FROM THE SOURCE FIRE..TYPICALLY OVER THE COURSE OF ONE OR MORE DAYS. AREAS OF BLOWING DUST ARE ALSO DESCRIBED. USERS ARE ENCOURAGED TO VIEW A GRAPHIC DEPICTION OF THESE AND OTHER PLUMES WHICH ARE LESS EXTENSIVE AND STILL ATTACHED TO THE SOURCE FIRE IN VARIOUS GRAPHIC FORMATS ON OUR WEB SITE:

JPEG: <http://www.ospo.noaa.gov/Products/land/hms.html>

GIS: <http://www.firedetect.noaa.gov/viewer.htm>

KML: <http://www.ssd.noaa.gov/PS/FIRE/kml.html>

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## August 17, 2015 Event Summary

Figure 2.8: Location of California Wildland Fires August 17, 2015

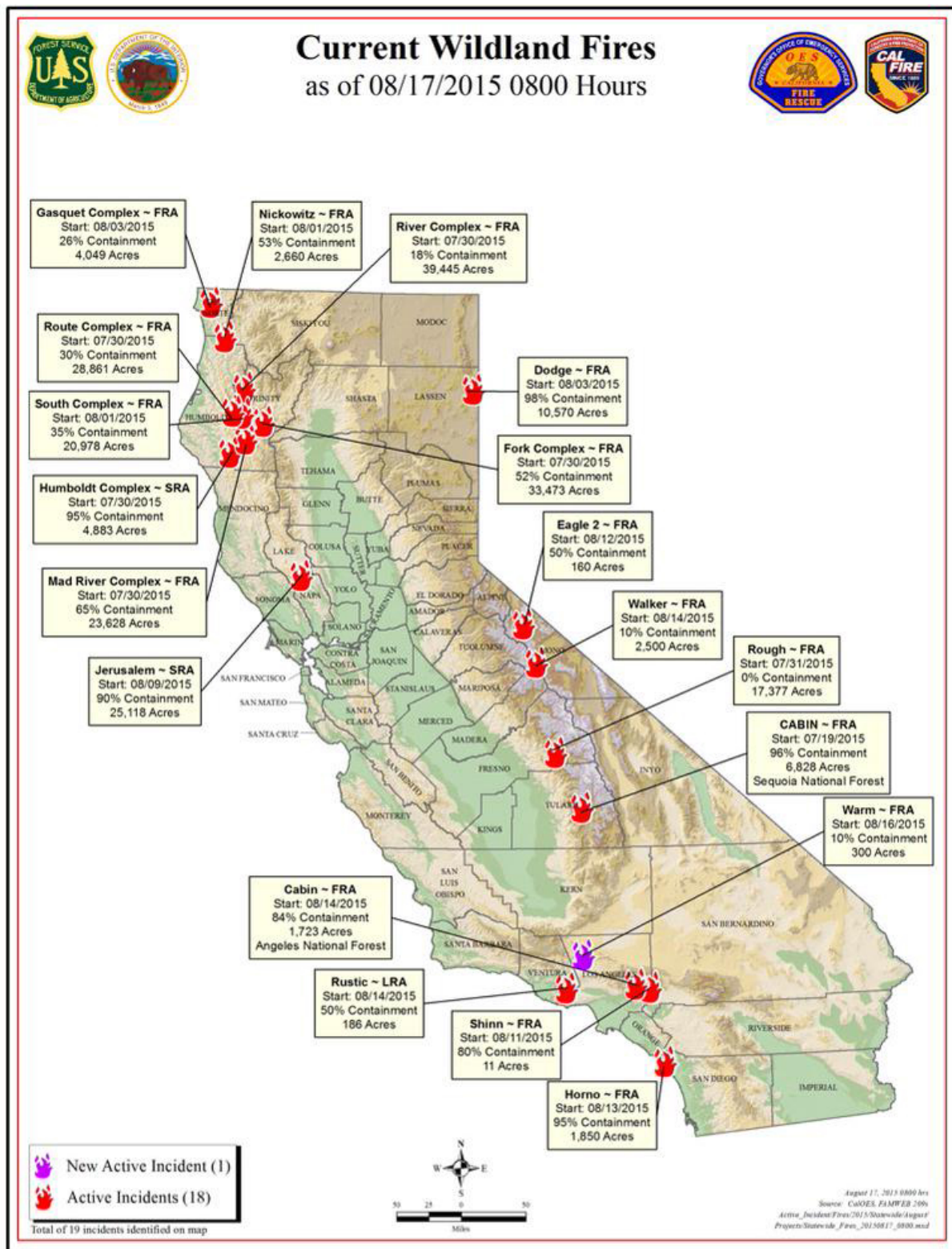




Figure 2.9: Satellite Image of the California and Pacific Northwest Wildfires August 17, 2015

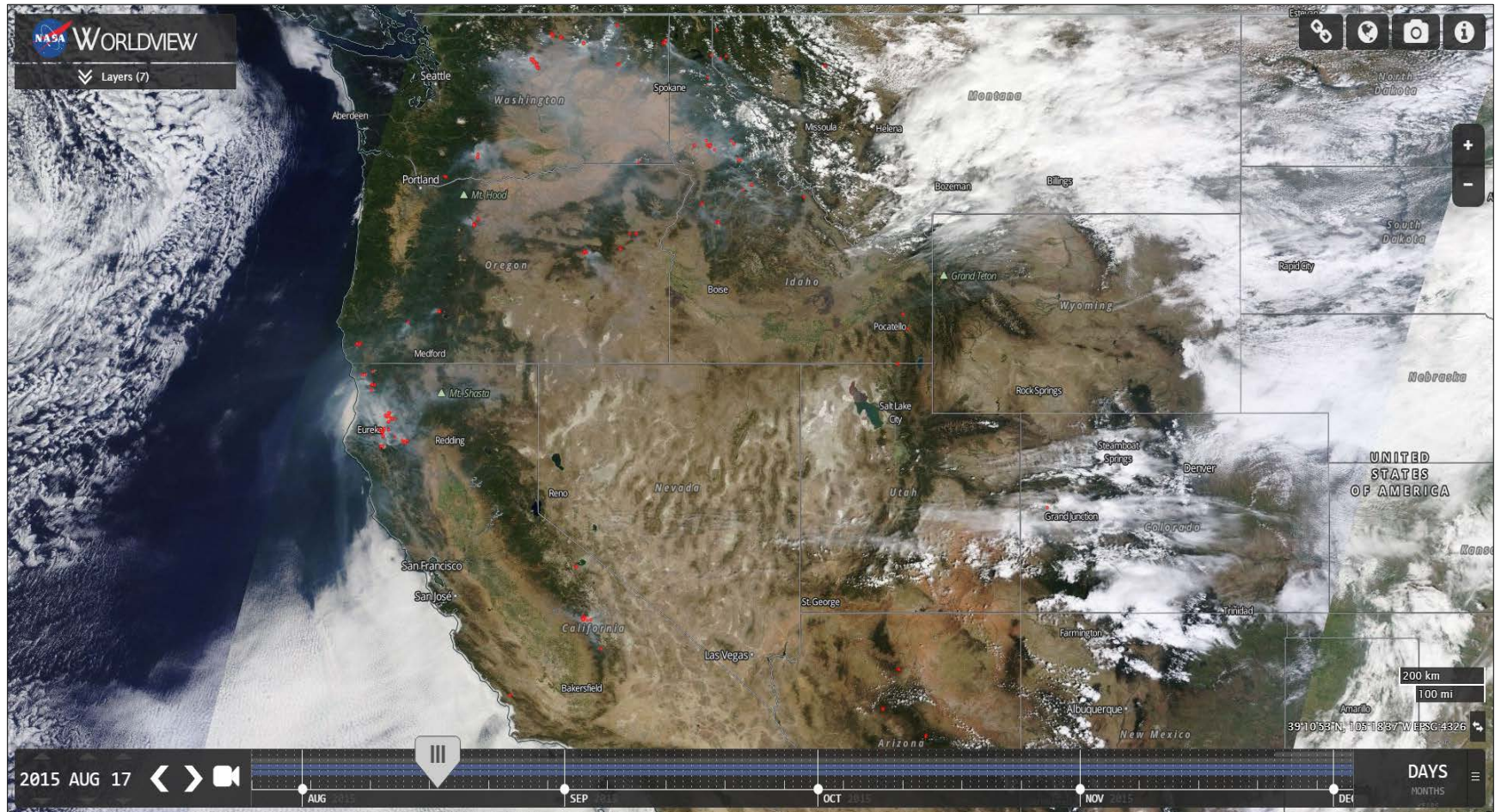




Figure 2.10: AirNow Tech Image of Active Fires, Smoke Plumes, and O<sub>3</sub> Concentrations throughout the Pacific Northwest  
August 17, 2015

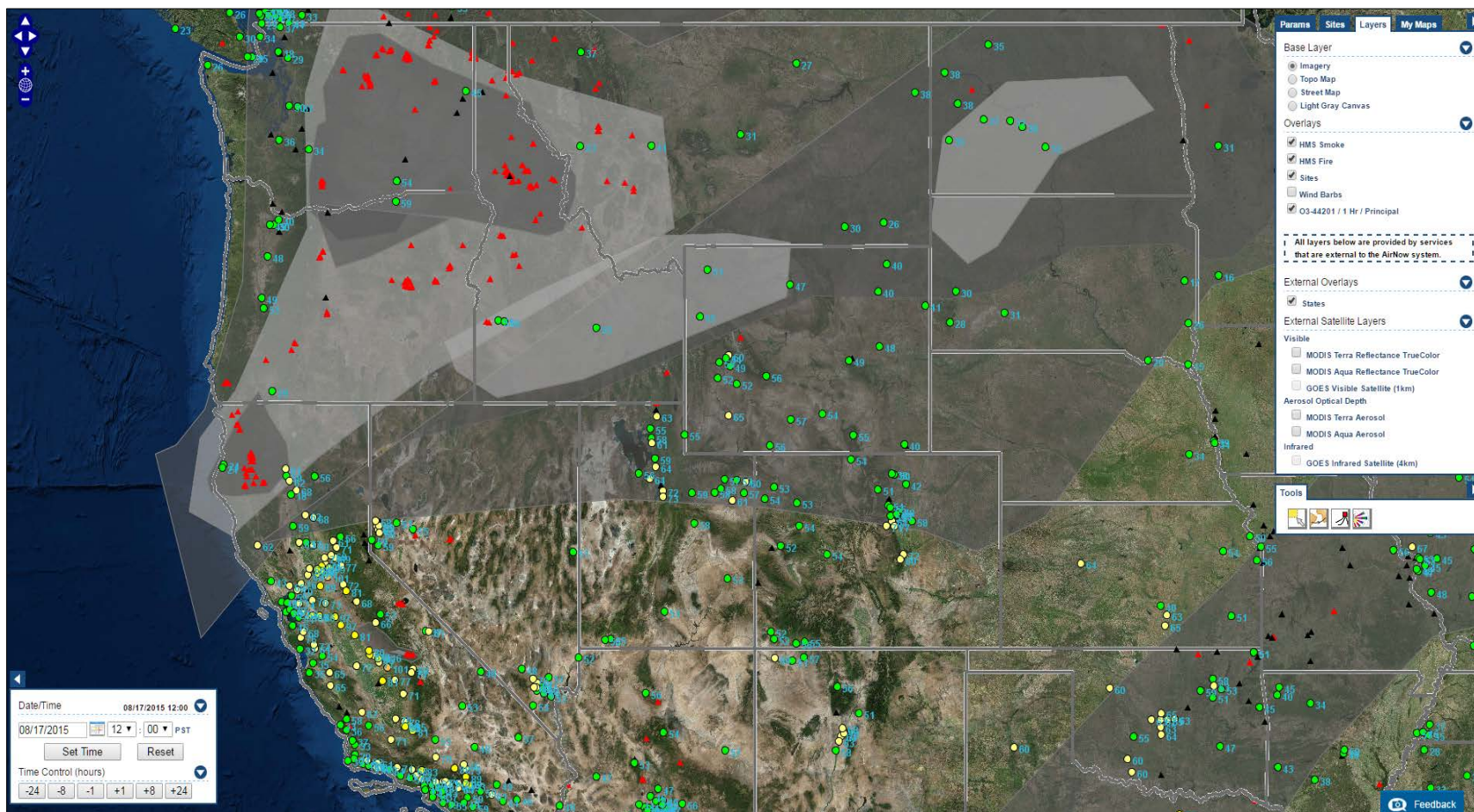


Figure 2.11: HMS Smoke Plume Map August 17, 2015

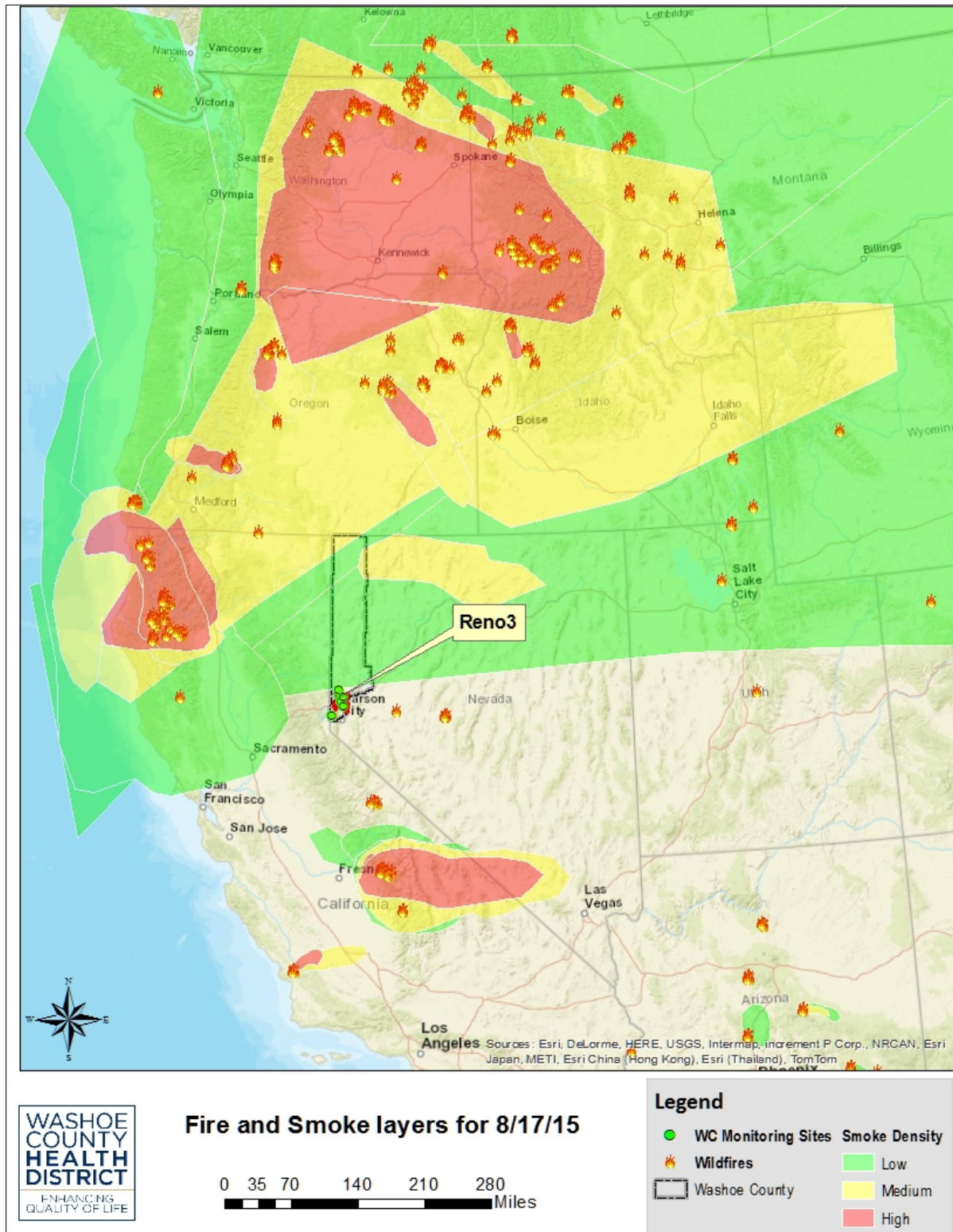




Figure 2.12: Satellite Smoke Text Product August 17, 2015

**Sunday, August 16, 2015**

**DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY  
THROUGH 0300Z August 17, 2015**

**SMOKE:**

**Western and Central US/Canada:**

A large area of light to heavy density smoke is visible being emitted from wildfires burning in the Pacific NW that stretches across the country. The heaviest smoke is visible around the large wildfire complexes located in California, Oregon, Washington, Idaho, and Montana. Medium-density smoke is visible throughout California, Nevada, Oregon, Washington, Idaho, Montana, Wyoming, North and South Dakota, and Minnesota into Ontario. Light density smoke is visible in a majority of central US moving east and south, affecting Michigan, Ohio, Indiana, Wisconsin, Illinois, Iowa, Missouri, Arkansas, Kansas, Oklahoma, and Texas. Another light density plume is seen in eastern Saskatchewan moving through northern Manitoba, southwestern Nunavut, through central Hudson Bay and into Northern Quebec.

**Northern and Central California:**

Areas of low to heavy density smoke from the cluster of fires in northern California is moving west to the Pacific along the coast. The fires in central California are also producing low to moderate density smoke heading northeast in to Nevada and joining the bigger smoke produced from the fires in northwestern US.

**Eastern US:**

Two areas of light to medium density remnant smoke are visible moving NE through the central US/Great Lakes region into the Mid-Atlantic/Northeast and offshore Atlantic Ocean. This smoke originates from the wildfires burning in the Pacific NW and Canada.

Oegerle

THIS TEXT PRODUCT IS PRIMARILY INTENDED TO DESCRIBE SIGNIFICANT AREAS OF SMOKE ASSOCIATED WITH ACTIVE FIRES AND SMOKE WHICH HAS BECOME DETACHED FROM THE FIRES AND DRIFTED SOME DISTANCE AWAY FROM THE SOURCE FIRE..TYPICALLY OVER THE COURSE OF ONE OR MORE DAYS. AREAS OF BLOWING DUST ARE ALSO DESCRIBED. USERS ARE ENCOURAGED TO VIEW A GRAPHIC DEPICTION OF THESE AND OTHER PLUMES WHICH ARE LESS EXTENSIVE AND STILL ATTACHED TO THE SOURCE FIRE IN VARIOUS GRAPHIC FORMATS ON OUR WEB SITE:

JPEG: <http://www.ospo.noaa.gov/Products/land/hms.html>

GIS: <http://www.firedetect.noaa.gov/viewer.htm>

KML: <http://www.ssd.noaa.gov/PS/FIRE/kml.html>

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## August 18, 2015 Event Summary

Figure 2.13: Location of California Wildland Fires August 18, 2015

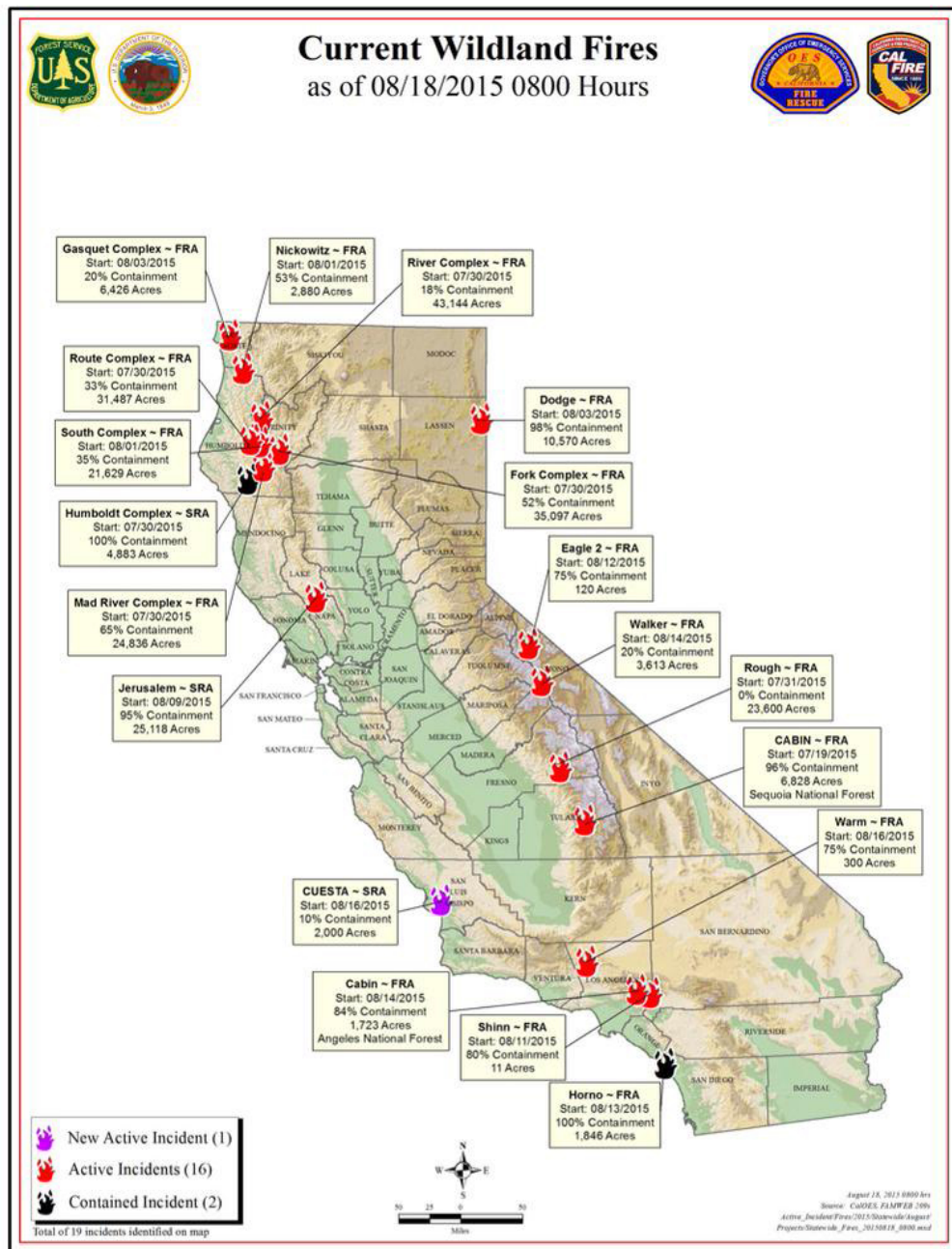




Figure 2.14: Satellite Image of the California and Pacific Northwest Wildfires August 18, 2015

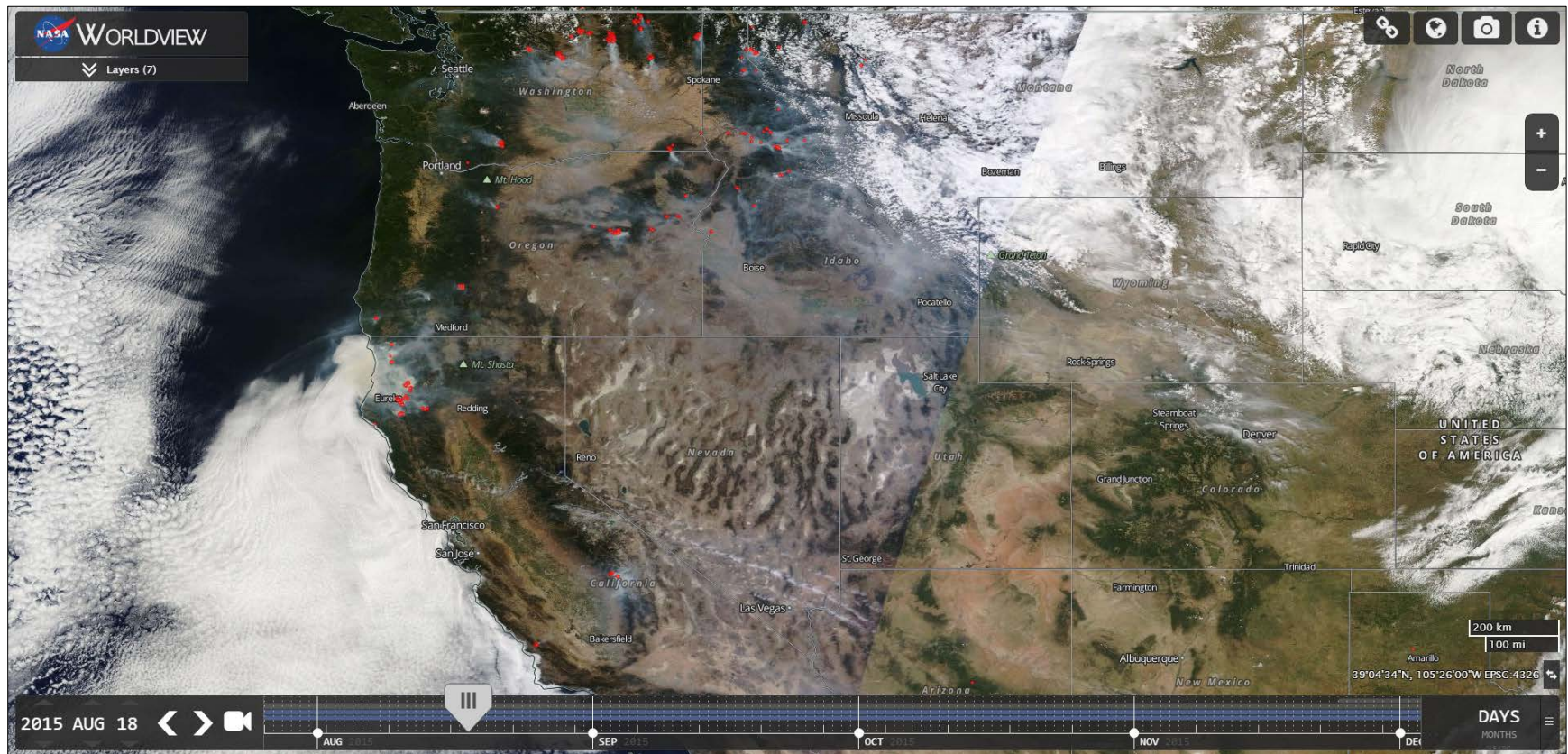




Figure 2.15: AirNow Tech Image of Active Fires, Smoke Plumes, and O<sub>3</sub> Concentrations throughout the Pacific Northwest  
August 18, 2015

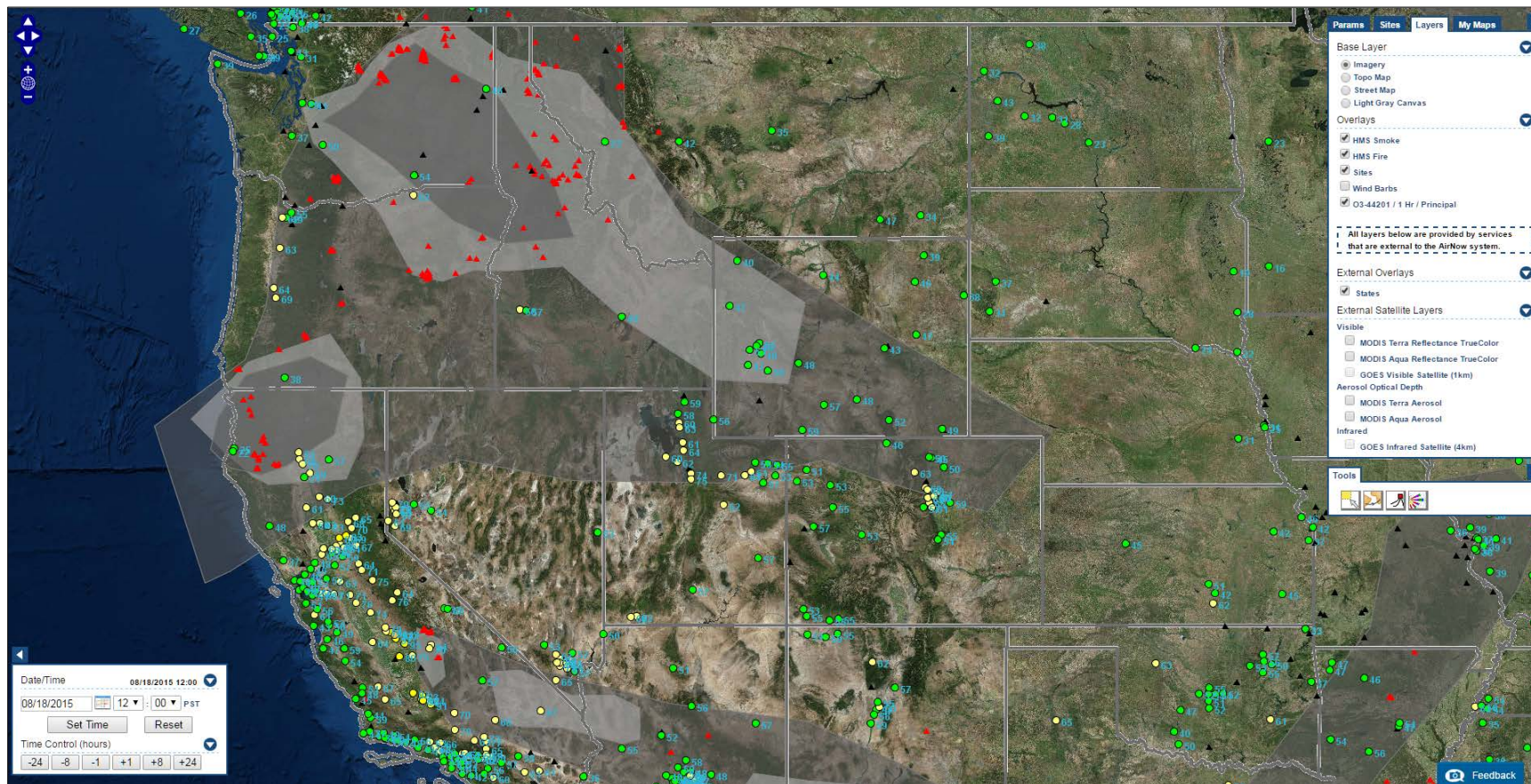




Figure 2.16: HMS Smoke Plume Map August 18, 2015

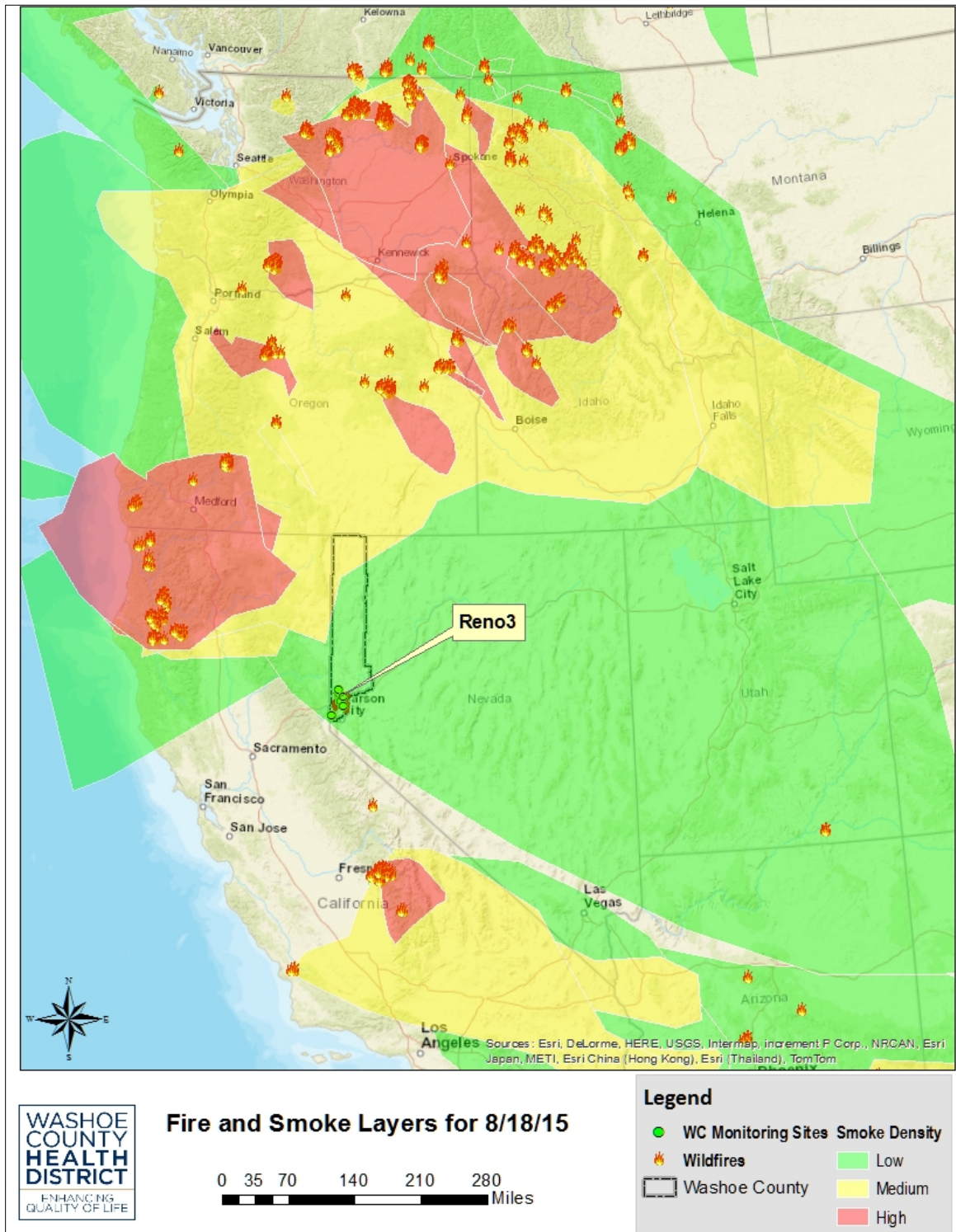




Figure 2.17: Satellite Smoke Text Product August 18, 2015

**Monday, August 17, 2015**

**DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY  
THROUGH 0230Z August 18, 2015**

**SMOKE:**

Western US/Plains/Southern Canada/Mississippi Valley/Upper Great  
Lakes/Ohio Valley:

Numerous wildfires burning across the Pacific Northwest and California  
are producing tremendous amounts of smoke over a large section of  
western/central US. Moderately dense to dense smoke is seen across  
sections of northern California, covering most of Oregon, northern  
Nevada, central/eastern Washington, Idaho, western Montana, northwest  
Wyoming and western North Dakota and South Dakota. The heaviest smoke  
is located over northwest California, northern Oregon, central/eastern  
Washington and into parts of northern Idaho. Lighter smoke spreads as  
far east as Minnesota, as far north as southern Alberta/Saskatchewan  
and as far south as northeast Kansas. Another area of residual smoke  
from the wildfires out west is seen over parts of the Southern Plains,  
spreading northeast across Texas, eastern/central Oklahoma, northeast  
Arkansas, southeast Kansas, most of Missouri, Illinois, western Indiana  
and up to northern Michigan.

Mid Atlantic and Northeast US/ far Eastern Canada/Atlantic

A large area of residual light smoke is seen as far south as Delaware  
and extending north across the northeast into New Hampshire, Mass,  
Conn, RI, Maine and north into eastern Quebec and far north as  
Labrador/Newfoundland.

Southeast California:

A large wildfire burning in east central Fresno county is producing  
a large area of moderately dense to very dense smoke across several  
counties. Smoke is seen in Tulare and Inyo counties in California and  
spreading east into the counties of Nye, Clark and Lincoln in southern  
Nevada.

J Kibler

THIS TEXT PRODUCT IS PRIMARILY INTENDED TO DESCRIBE SIGNIFICANT AREAS  
OF SMOKE ASSOCIATED WITH ACTIVE FIRES AND SMOKE WHICH HAS BECOME  
DETACHED FROM THE FIRES AND DRIFTED SOME DISTANCE AWAY FROM THE SOURCE  
FIRE..TYPICALLY OVER THE COURSE OF ONE OR MORE DAYS. AREAS OF BLOWING DUST  
ARE ALSO DESCRIBED. USERS ARE ENCOURAGED TO VIEW A GRAPHIC DEPICTION OF  
THESE AND OTHER PLUMES WHICH ARE LESS EXTENSIVE AND STILL ATTACHED TO  
THE SOURCE FIRE IN VARIOUS GRAPHIC FORMATS ON OUR WEB SITE:

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Figure 2.18: Media Coverage August 18, 2015



## August 19, 2015 Event Summary

Figure 2.19: Location of California Wildland Fires August 19, 2015

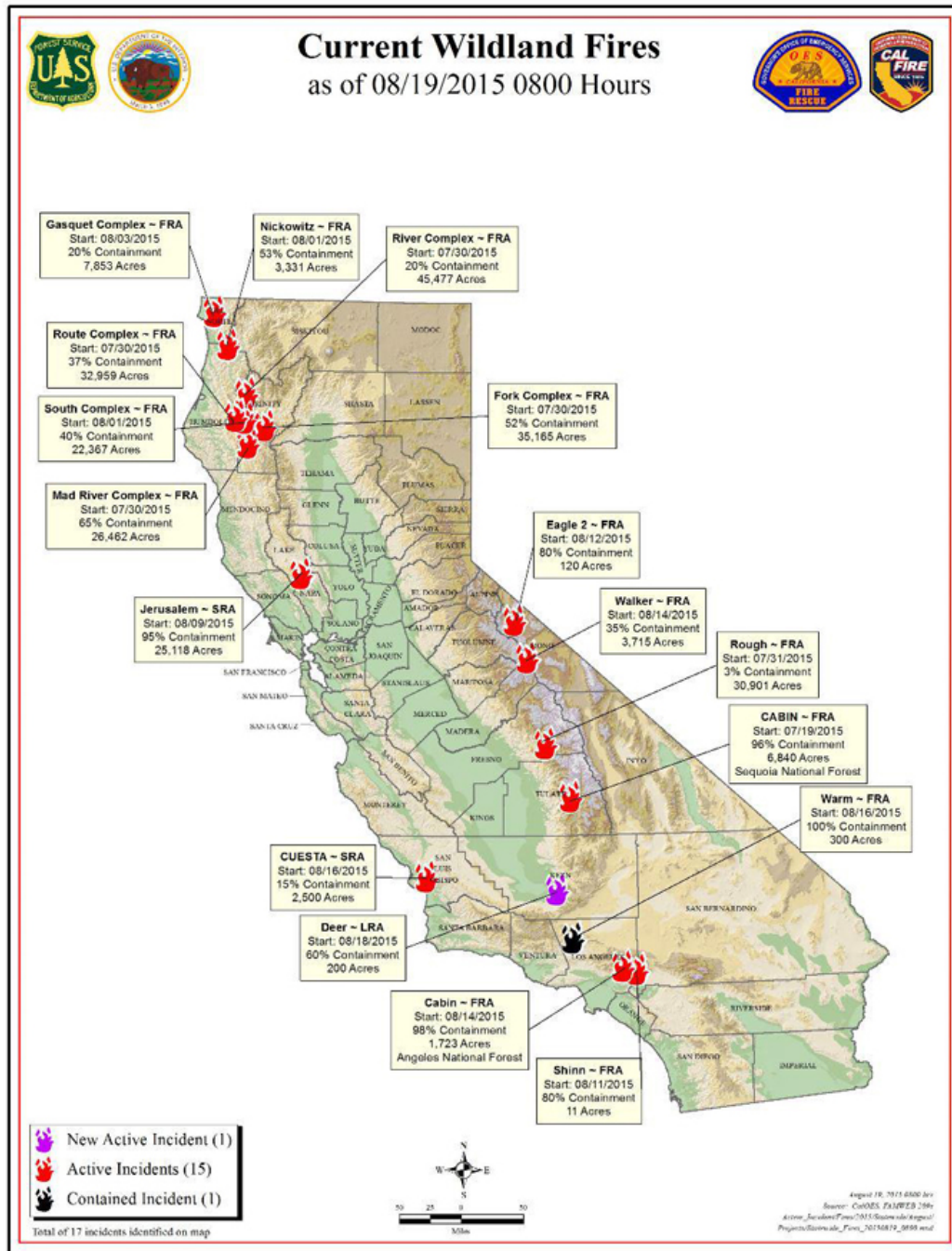




Figure 2.20: Satellite Image of the California and Pacific Northwest Wildfires August 19, 2015

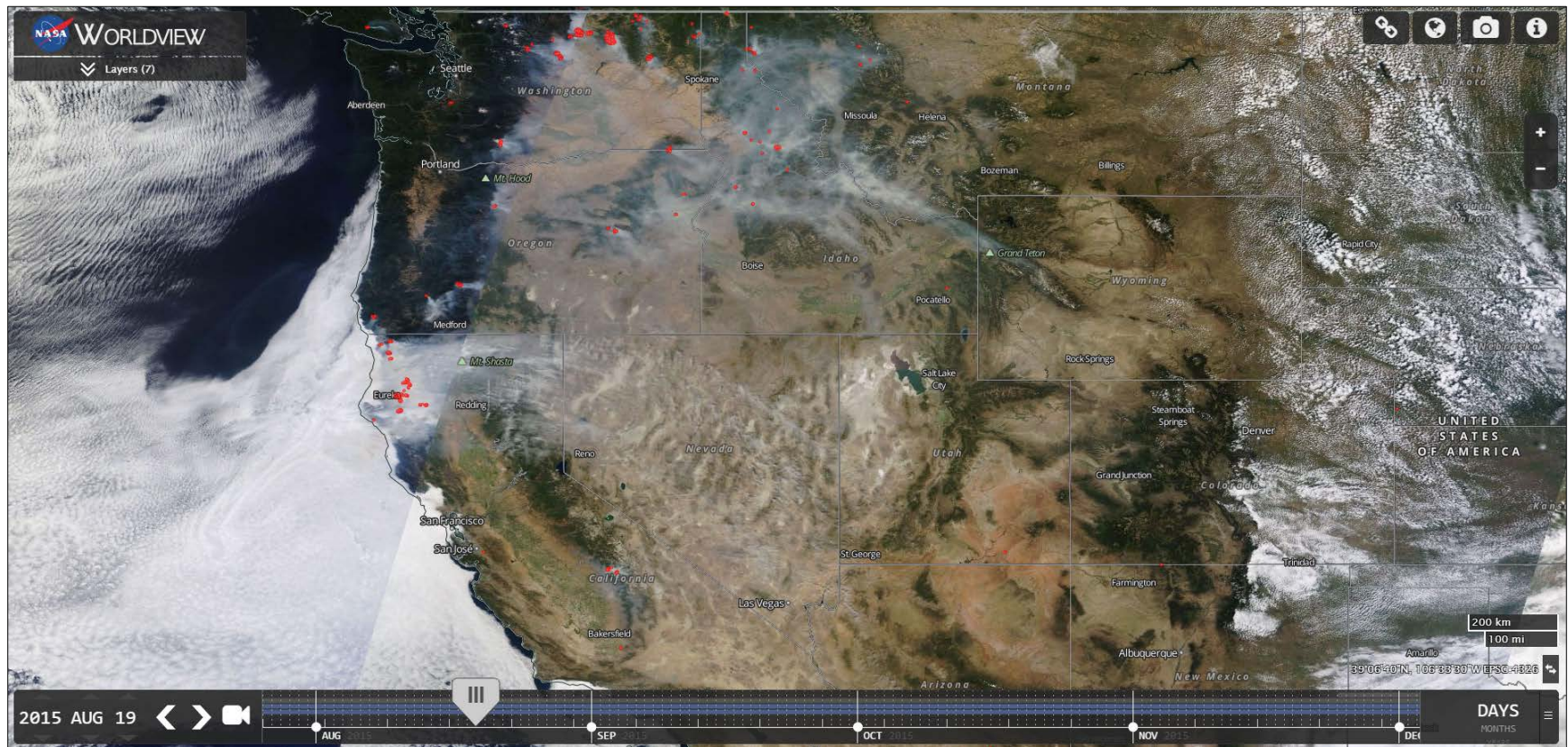




Figure 2.21: AirNow Tech Image of Active Fires, Smoke Plumes, and O<sub>3</sub> Concentrations throughout the Pacific Northwest  
August 19, 2015

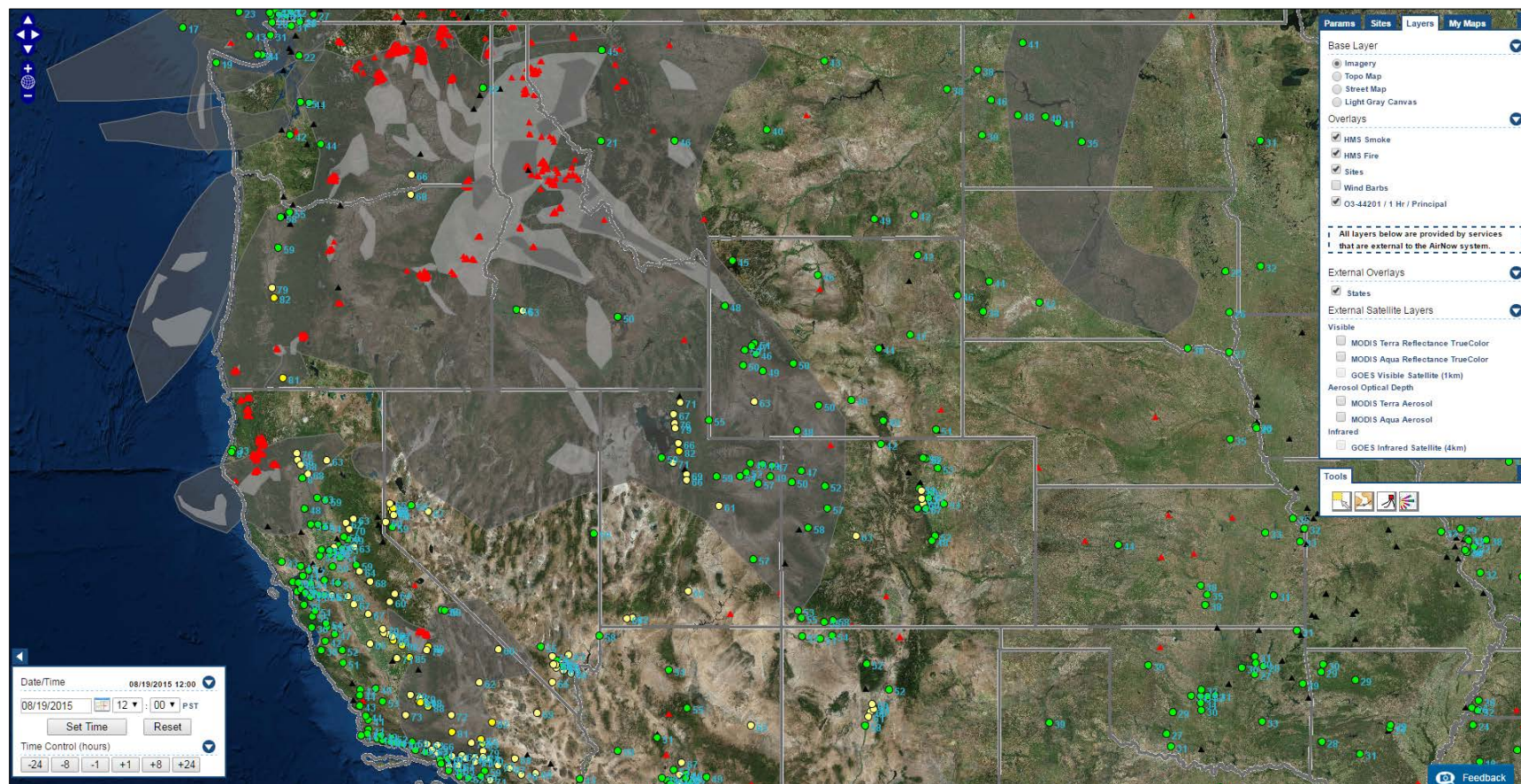




Figure 2.22: HMS Smoke Plume Map August 19, 2015

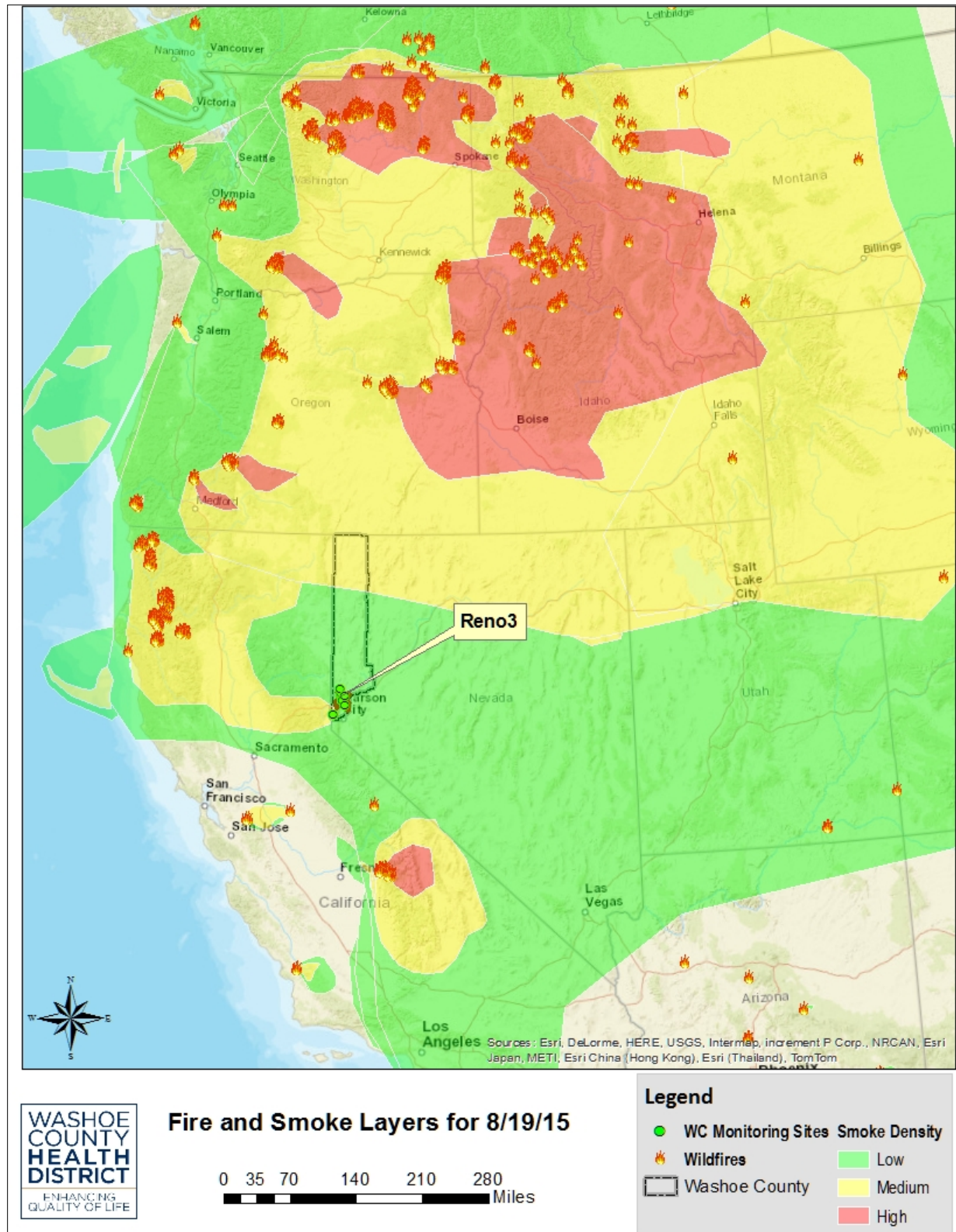


Figure 2.23: Satellite Smoke Text Product August 19, 2015

**Wednesday, August 19, 2015**

**DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY  
THROUGH 1815Z August 19, 2015**

**SMOKE:**

**Western US/SW Canada:**

Large areas of smoke ranging from light to heavy density are visible over a majority of the western US as well as southwest Canada. The heaviest smoke is visible over parts of Oregon, Washington, Idaho, and Montana. Moderate density smoke is visible in this region as well, extending south Nevada as well as over areas of California where other wildfires are burning. The lighter smoke spreads as far east as Colorado and as far north as southern British Columbia. This smoke is mostly from large wildfires burning in the western US. In addition, over parts of Alberta and British Columbia, mostly thin smoke that appears to have originated from Asia is seen moving southeastward.

**North Central US/South Central Canada/Hudson Bay:**

An area of smoke wraps around the backside of an upper low over the Midwest. The smoke extends from the Dakotas north and then northeast across southern Manitoba and along the Manitoba/Ontario border. Another area of thin smoke is present of Hudson Bay as well. This smoke is likely from fires in the western US.

**Northeast US/Eastern Canada:**

Areas of residual light smoke are seen as far south southern New England extending north and northeast towards Maine and south of Nova Scotia. Other thin smoke is seen over the Gulf of St. Lawrence and across parts of Newfoundland. This smoke originates from the wildfires in the Pacific Northwest. Additional aerosol seen mixed between clouds over the Great Lakes may be smoke-related but could not be confirmed given the general hazy appearance.

**DUST**

**Texas/New Mexico:**

An aerosol seen over southern New Mexico and west/central Texas is believed to be elevated dust particles.

**Gulf of California:**

Optically thick dust particles can be seen in the morning GOES imagery moving west and southwest from northwest Mexico across portions of the Gulf of California.

**Sheffler**

THIS TEXT PRODUCT IS PRIMARILY INTENDED TO DESCRIBE SIGNIFICANT AREAS OF SMOKE ASSOCIATED WITH ACTIVE FIRES AND SMOKE WHICH HAS BECOME DETACHED FROM THE FIRES AND DRIFTED SOME DISTANCE AWAY FROM THE SOURCE FIRE. TYPICALLY OVER THE COURSE OF ONE OR MORE DAYS. AREAS OF BLOWING DUST ARE ALSO DESCRIBED. USERS ARE ENCOURAGED TO VIEW A GRAPHIC DEPICTION OF THESE AND OTHER PLUMES WHICH ARE LESS EXTENSIVE AND STILL ATTACHED TO THE SOURCE FIRE IN VARIOUS GRAPHIC FORMATS ON OUR WEB SITE:

JPEG: <http://www.ospo.noaa.gov/Products/land/hms.html>

GIS: <http://www.firedetect.noaa.gov/viewer.htm>

KML: <http://www.ssd.noaa.gov/PS/FIRE/kml.html>

ANY QUESTIONS OR COMMENTS REGARDING THIS PRODUCT SHOULD BE SENT TO  
SSDFireTeam@noaa.gov



Figure 2.24: Media Coverage August 19, 2015



## 2.4 Event Related Concentrations

On August 18 and 19, 2015 the AQMD monitored 5 exceedances of the 8-hour O<sub>3</sub> NAAQS, with the highest concentration reaching 0.075 parts per million (ppm) at the Reno3 monitoring site. Wildfire smoke and O<sub>3</sub> precursors from wildfires throughout the Pacific Northwest were transported into Nevada on prevailing winds resulting in the O<sub>3</sub> exceedances at the Reno3 monitoring site. Elevated PM<sub>2.5</sub> and NO<sub>x</sub> concentrations support the presence of wildfire smoke.

Table 2.1 below lists O<sub>3</sub> concentrations across the ambient air monitoring network on August 18 and 19, 2015 monitored during the exceptional event. Refer to Table 2.1 in the 2015 EE Demonstration for the 8-hour O<sub>3</sub> concentrations for seven days before and after the wildfire events. It highlights the elevated concentrations and exceedance at the Reno3 site during the event.

Table 2.1: 8-hour O<sub>3</sub> Concentrations (ppm)

Monitoring Site	08/18	08/19
Reno3	0.075	0.073
Sparks	0.070	0.071
Toll	0.068	0.069
South Reno	0.073	0.071
Lemmon Valley	0.069	0.067
Incline	0.063	0.061

*In this exceptional event addendum, AQMD is requesting to exclude all hourly O<sub>3</sub> data from the Reno3 monitoring site for August 18 and 19, 2015 from 0000 Pacific Standard Time (PST) to 2300 PST from comparison to the NAAQS. Exclusion of the data caused by this exceptional event will have a regulatory impact on the attainment designation of the 2015 8-hour O<sub>3</sub> NAAQS.*

Figure 2.13 shows the PM<sub>2.5</sub>, O<sub>3</sub>, and NO<sub>x</sub> concentrations at the Reno3 site seven days before and after the August 2015 events. These pollutants were elevated, especially on all three exceptional event days in August 2015 (August 18, 19, and 21, 2015). This supports the demonstration that the increase in wildfire smoke also increased NO<sub>x</sub> concentrations, which increased O<sub>3</sub> levels.

Figure 2.14 shows O<sub>3</sub> and PM<sub>2.5</sub> concentrations at all other monitoring sites throughout the network. The elevated concentrations throughout the monitoring network demonstrate that the wildfire smoke impacts were regional and consistent with dispersion from fires 300 to 1,000 kilometers (km) away.

Figure 2.25: Reno3 O<sub>3</sub>, NO<sub>x</sub>, and PM<sub>2.5</sub> Hourly Concentrations for August 14-28, 2015

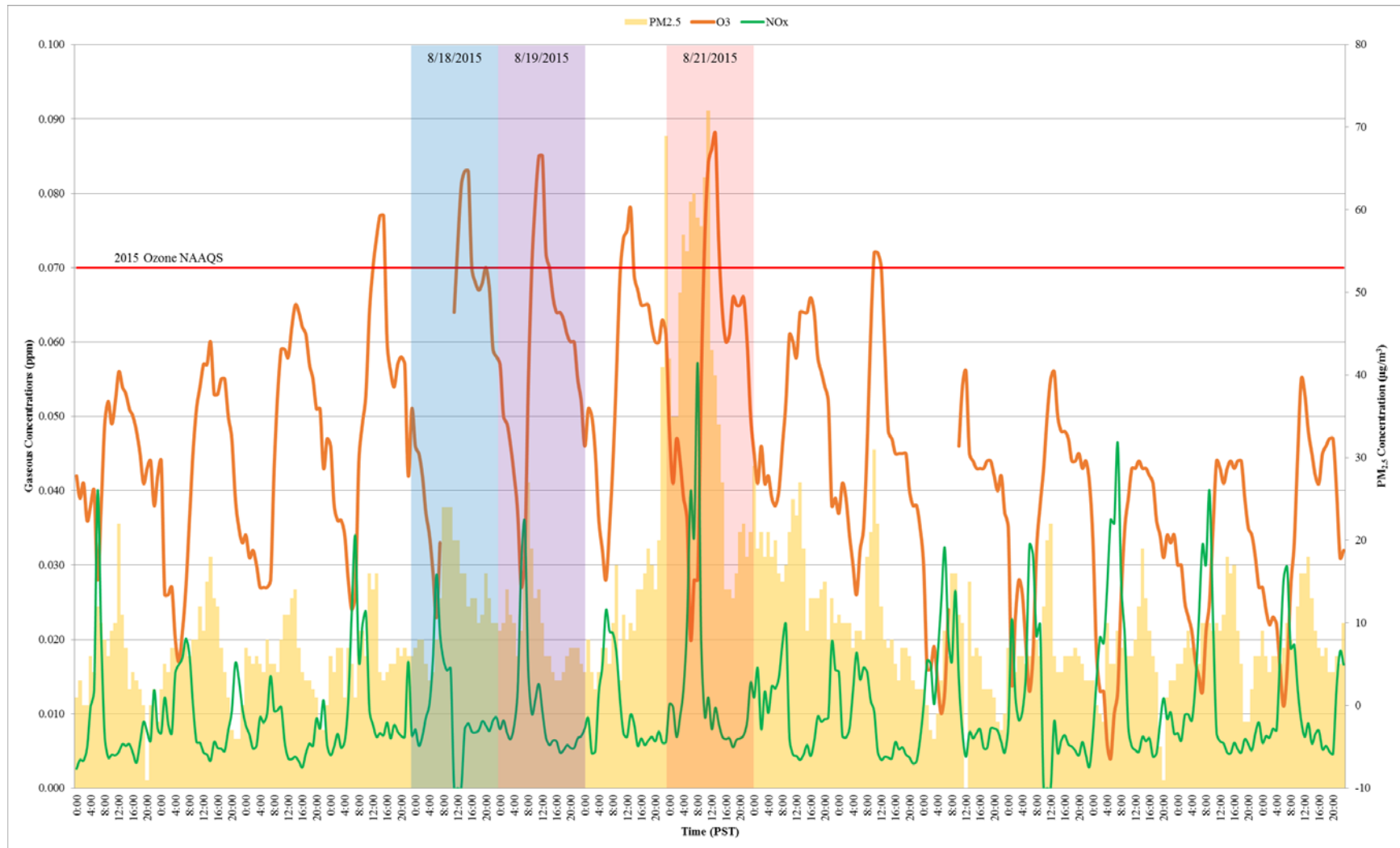
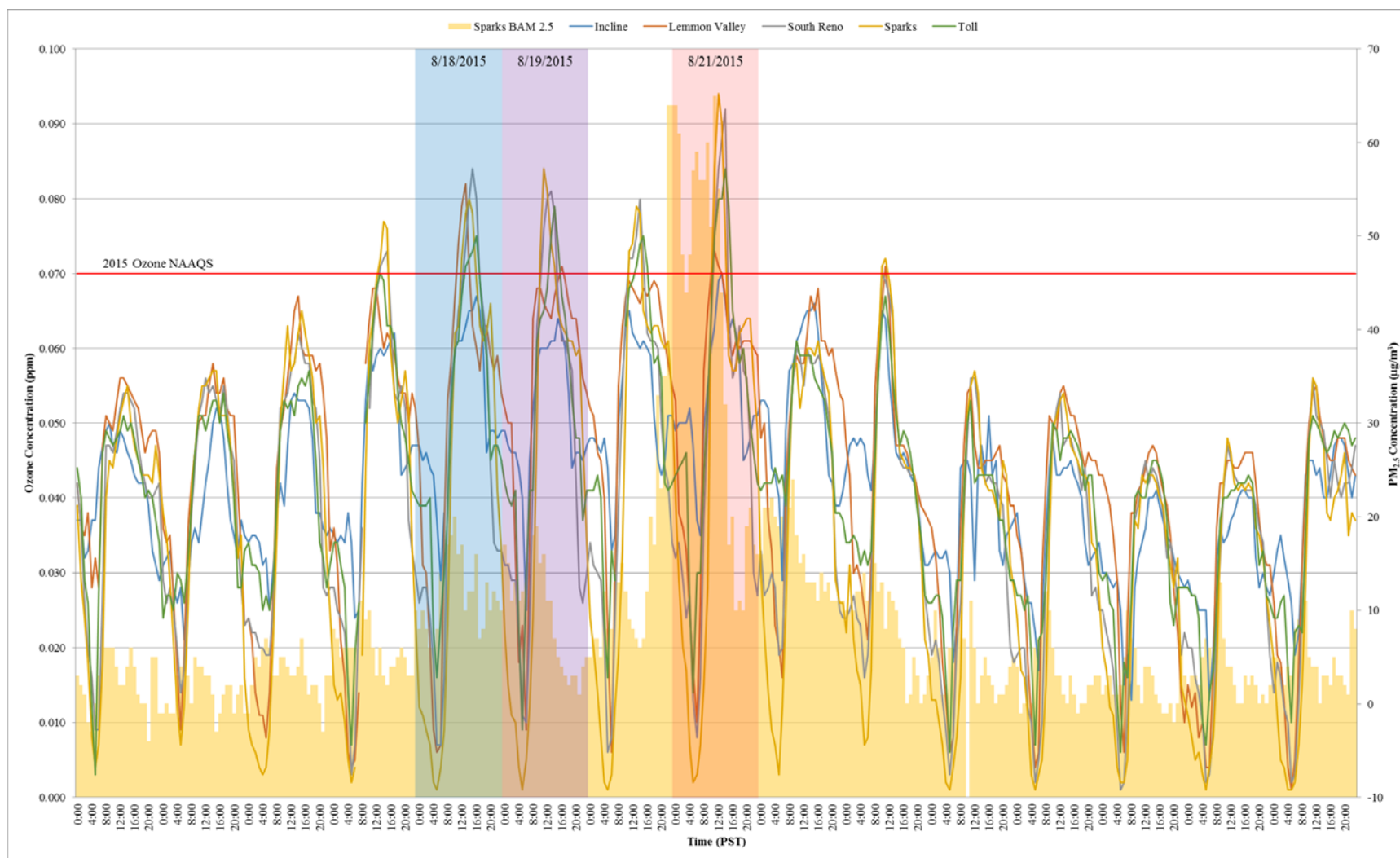


Figure 2.26 Sparks, Incline, Lemmon Valley, South Reno, and Toll O<sub>3</sub> and PM<sub>2.5</sub> Hourly Concentrations for August 14-28, 2015





## 2.5 Meteorological Conditions

Refer to the 2015 EE Demonstration for detailed daily weather and visibility.

### Event Weather Summary

Temperature and wind speed data were analyzed days before, during, and after the exceptional events. August 16 and 25 were selected as shoulder days around the events because these were regular sample days for the PM<sub>2.5</sub> Speciation monitor. The table below summarizes the period from August 16 to 25. Weather observations are from the Reno-Tahoe International Airport, approximately three miles southeast of the Reno3 monitoring station.

Table 2.2: Temperature and Wind Speed on Exceptional Events and Non-Event Days

Parameter	08/16	08/18	08/19	08/21	08/25
O <sub>3</sub>					
8-hour maximum (ppb)	0.061	0.075	0.073	0.073	0.049
Maximum Temperature					
Observed (°F)	98	98	98	95	96
Normal (°F)	91	90	90	90	89
Wind Speed					
24-hour Observed (mph)	5.8	4.9	5.7	6.5	6.9
24-hour Normal (mph)	6.6	6.6	6.6	6.6	6.6
2-min Observed (mph)	26	18	22	22	23

Temperatures on August 16 were as high, or higher, than the event but 8-hour O<sub>3</sub> concentrations were at least 0.012 ppm lower. The temperature on August 25 was comparable to the event, but concentrations were up to 0.026 ppm lower. The typical Washoe Zephyr Winds were present each afternoon.

The weather data further support the 2015 EE Demonstration that wildfire smoke affected the Reno3 monitor and increased O<sub>3</sub> concentrations. Unusual weather (other than transport of wildfire smoke) was not a factor contributing to the exceptional event.

## 2.6 Meteorological Assessment of Smoke Influence in Northwestern Nevada

Refer to the 2015 EE Demonstration.

## 2.7 Media Coverage

Refer to Section 2.3 of this addendum.

### 3.0 CLEAR CAUSAL RELATIONSHIP

#### 3.1 Introduction

Refer to the 2015 EE Demonstration.

#### 3.2 Comparison of Event-Related Concentrations with Historical Concentrations

As part of demonstrating a clear causal relationship between the wildfire event and the O<sub>3</sub> exceedance, historical, non-event O<sub>3</sub> season concentrations were compared to the August 18 and 19, 2015 events. Graphs of the 5-year historical O<sub>3</sub> seasonal concentrations are shown in Figures 3.1 and 3.2, with the Reno3 O<sub>3</sub> exceedances represented as squares in each figure. The 99<sup>th</sup> percentile value for the O<sub>3</sub> season (June through August), which is the O<sub>3</sub> exceedance on August 19 and 21, 2015 event, is 0.073 ppm.

Figures 3.3 and 3.4 show the hourly seasonal percentiles for O<sub>3</sub> from 2010-2015 as compared to the concentrations of O<sub>3</sub> formation on August 18 and 19, 2015. This data clearly demonstrates that smoke from the 2015 wildfire events caused an increase in O<sub>3</sub> concentrations at the Reno3 site on August 18 and 19, 2015.

Figure 3.1: Reno3 8-Hour Daily O<sub>3</sub> Season Maximums June-August, 2010-2015

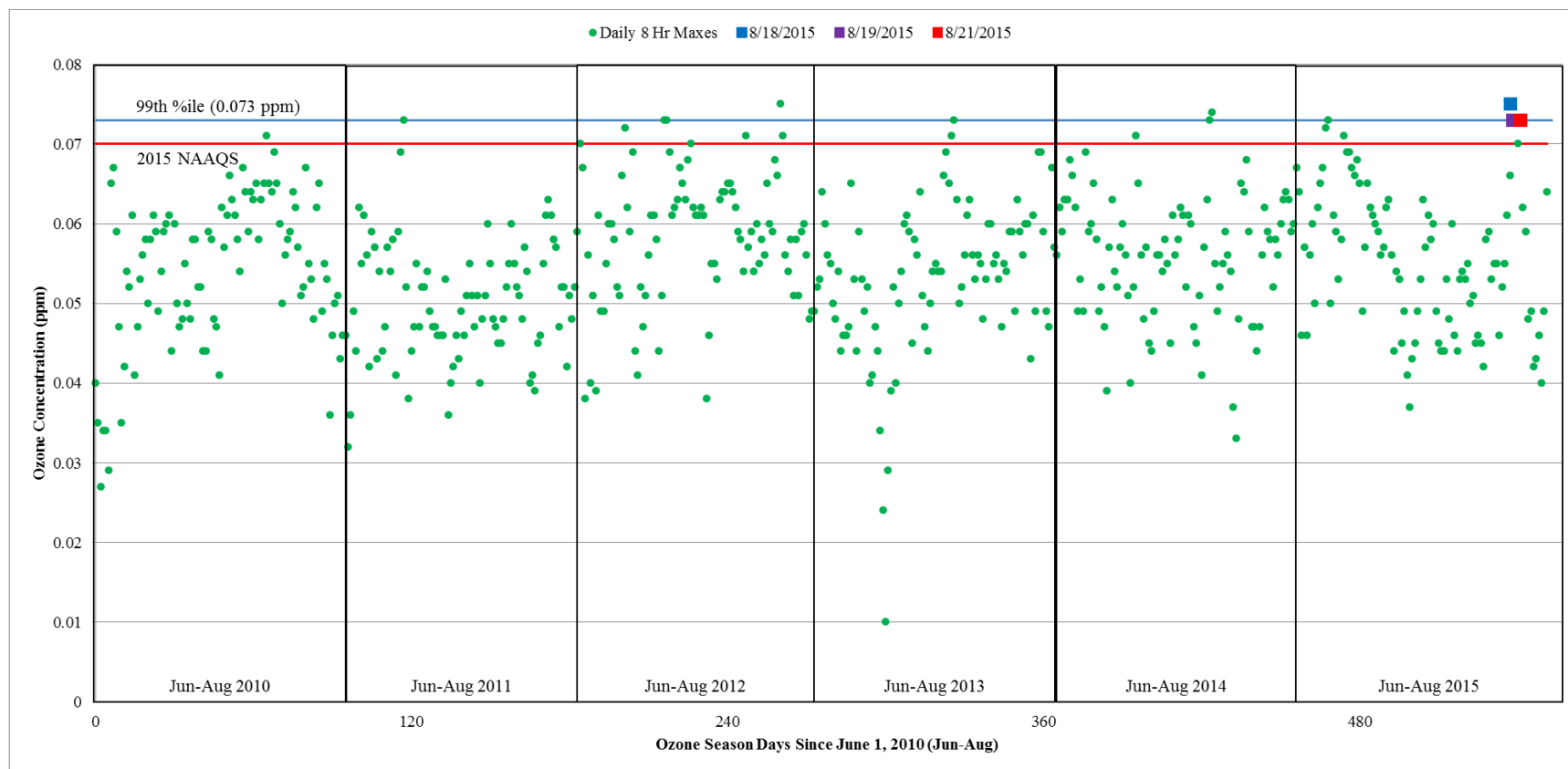




Figure 3.2: Reno3 8-Hour O<sub>3</sub> Daily Maximums June-August, 2010-2015

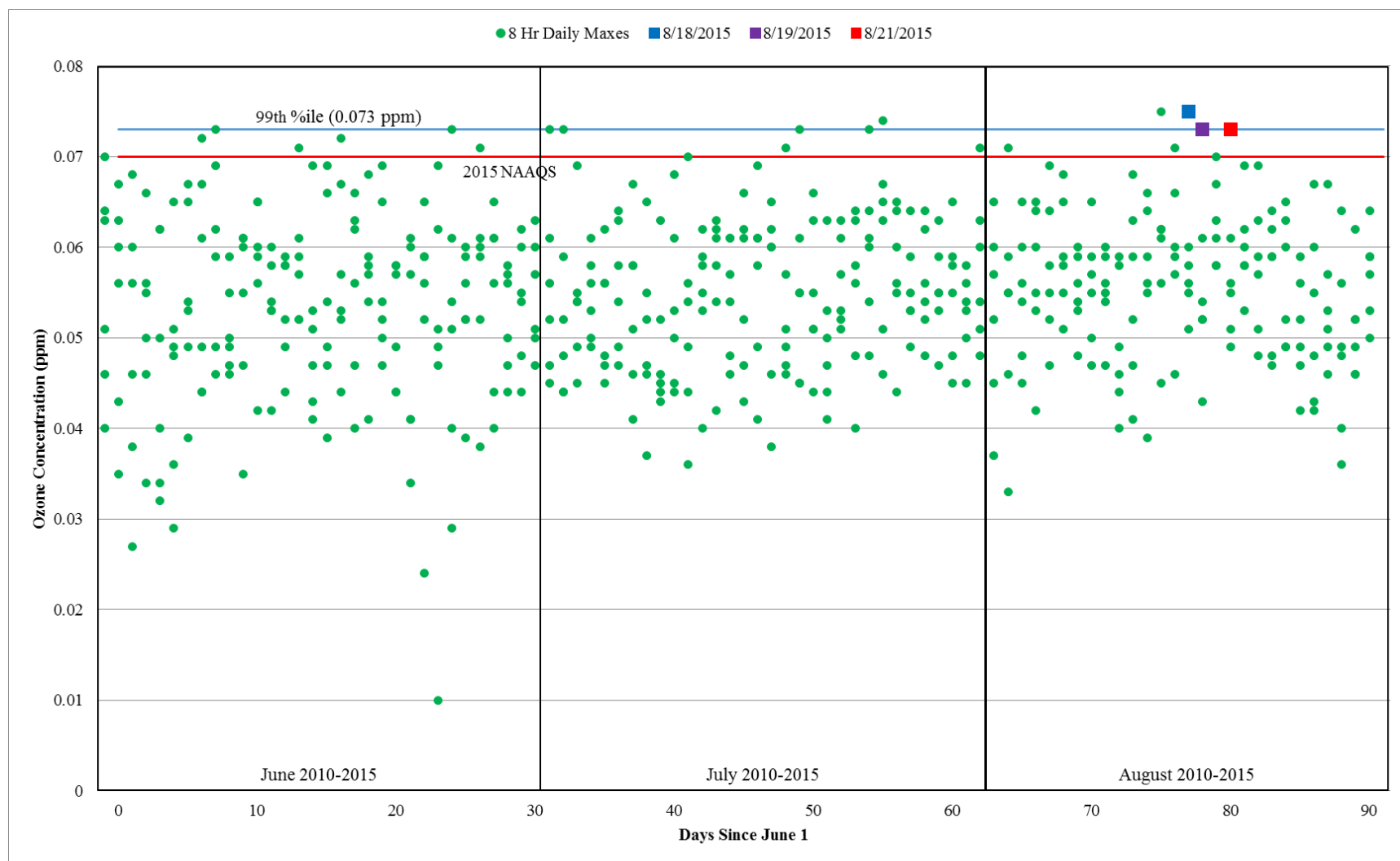


Figure 3.3: Percentiles for Hourly Seasonal O<sub>3</sub> for 2010-2014 with August 18, 2015

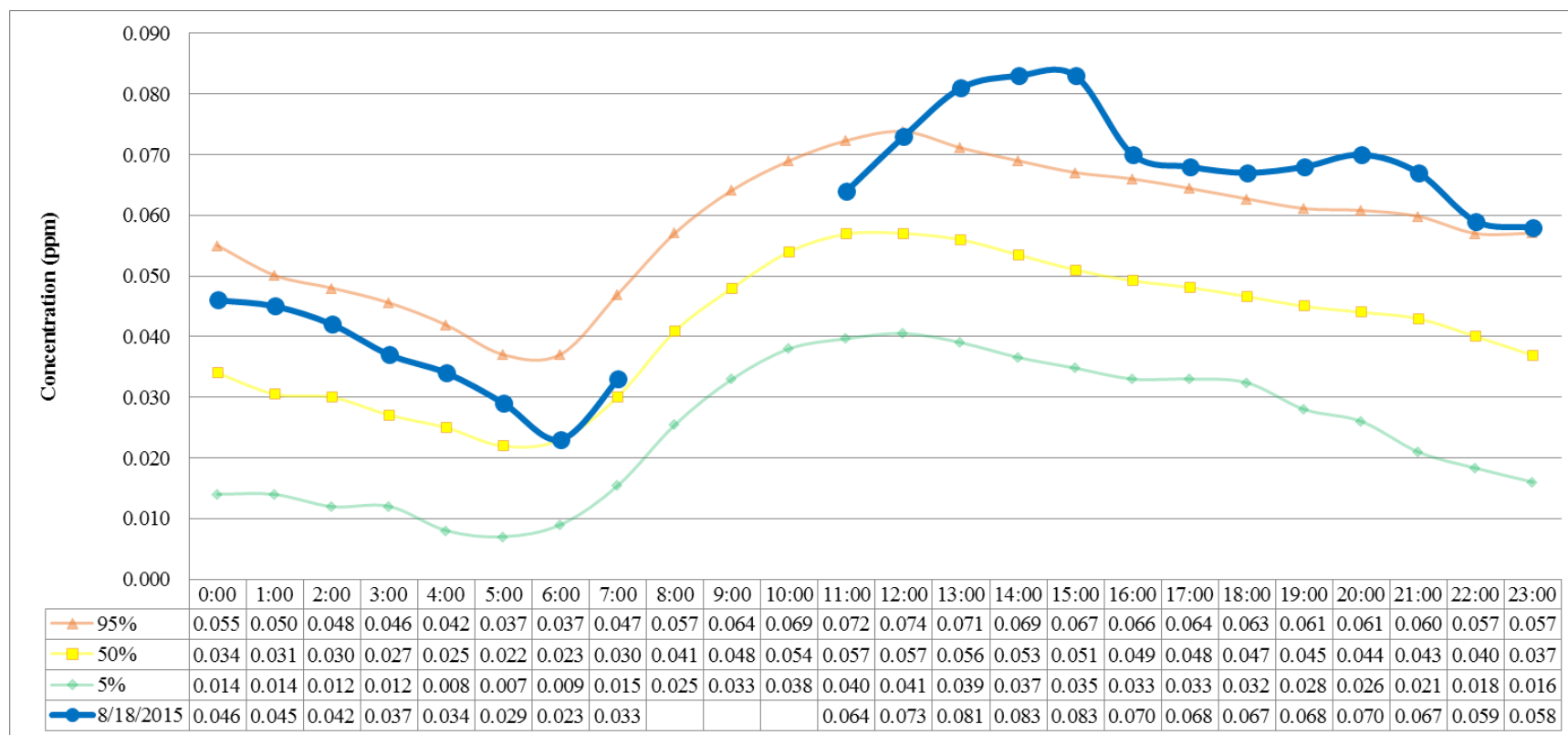
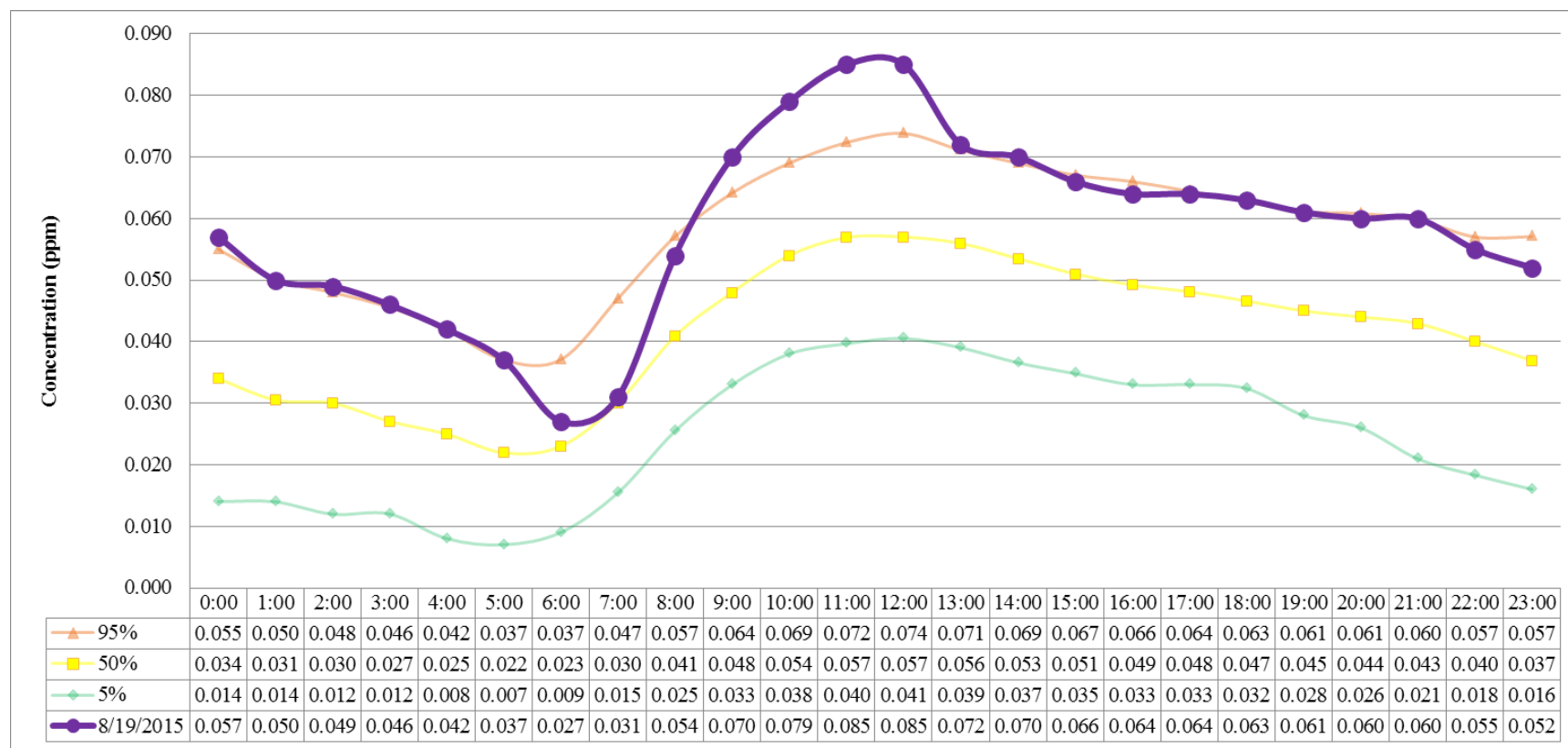


Figure 3.4: Percentiles for Hourly Seasonal O<sub>3</sub> for 2010-2014 with August 19, 2015





### 3.3 Tier 2 Approach

Refer to the 2015 EE Demonstration.

#### Key Factor #1

The differences between this addendum and the 2015 EE Demonstration are listed below.

1. The addendum includes three additional evaluation days (August 17, 18, and 19).
2. Impacts from the Oregon and Washington wildfires are evaluated in the addendum.
3. Tables 3.1 and 3.2 in the 2015 EE Demonstration incorrectly listed distances in miles instead of km. Q/D calculations correctly used km and the Q/D ratios in those tables are correct. Revised tables for August 20 and 21 with the correct distance units are included in this section.

BlueSky Playground inputs used in the 2015 EE Demonstration were also used to calculate emissions for August 17, 18, and 19. These inputs were: 1) Emission Type = “Wildfire”, 2) Fuel Moisture Condition = “Very Dry”, and 3) FCCS Fuelbed # = default by location.

It is important to note that the fire origination location was used to determine FCCS Fuelbed # and distance (D). This is the practical approach to using BlueSky Playground, however it can introduce differences in both Q and D. First, as wildfires grow, the emissions are generated from polygons instead of a single point. These polygons are located away from the fire origination locations used in BlueSky Playground and can increase or decrease the actual distance from the fire to the monitor. Secondly, a change in fire location inputs for BlueSky Playground can result in a different FCCS Fuelbed # leading to different emission factors and emissions.

Following are Q/D calculations for August 17-21, 2015.

Table 3.1: Q/D Calculations for Monday, August 17, 2015

Fire Location/ Name	Lat/Long	Distance (km)	Acres Burned	Emissions (tons)	Q/D (tpd/km)
NW California/					
Fork Complex	40.45/-123.128	301	775	465	2
Mad River Complex	40.34/-123.383	317	821	1,493	5
South Complex	40.62/-123.448	332	896	569	2
Route Complex	40.64/-123.586	345	1,060	1,927	6
River Complex	40.91/-123.437	345	2,280	2,039	6
Nickowitz	41.47/-123.750	396	671	600	2
Gasquet Complex	41.85/-123.969	436	288	258	1
Total			6,791	7,351	
Oregon*/					
Canyon Creek	44.28/-118.96	561	NA		
Washington*/					
Kettle	48.76/-118.461	1,066	NA		
Grizzly Bear	46.11/-117.679	814	NA		
Okanogan	48.519/-119.662	1,038	NA		

\*Detailed information on acres burned for the Oregon and Washington fires on August 17, 2015 were not readily available, therefore the Q/D was not calculated.

Table 3.2: Q/D Calculations for Tuesday, August 18, 2015

Fire Location/ Name	Lat/Long	Distance (km)	Acres Burned	Emissions (tons)	Q/D (tpd/km)
NW California/					
Fork Complex	40.45/-123.128	301	1,624	1,031	3
Mad River Complex	40.34/-123.383	317	1,208	2,196	7
South Complex	40.62/-123.448	332	651	413	1
Route Complex	40.64/-123.586	345	2,626	4,774	14
River Complex	40.91/-123.437	345	3,699	3,308	10
Nickowitz	41.47/-123.750	396	671	600	2
Gasquet Complex	41.85/-123.969	436	2,377	2,126	5
Total			12,856	14,448	
Oregon/					
Canyon Creek	44.28/-118.96	561	6,619	4,795	9
Washington/					
Kettle*	48.76/-118.461	1,066	NA		
Grizzly Bear**	46.11/-117.679	814	4,000*	7,255	9
Okanogan	48.519/-119.662	1,038	933	13	<1

\*Detailed information on acres burned for the Kettle Fire on August 18, 2015 was not readily available; therefore Q/D was not calculated.

\*\*Detailed information on acres burned between August 17 and 19, 2015 were not readily available, therefore the total acres burned for the two days (8,000) were divided to determine Q.



Table 3.3: Q/D Calculations for Wednesday, August 19, 2015

Fire Location/ Name	Lat/Long	Distance (km)	Acres Burned	Emissions (tons)	Q/D (tpd/km)
NW California/					
Fork Complex	40.45/-123.128	301	68	43	<1
Mad River Complex	40.34/-123.383	317	1,626	2,956	9
South Complex	40.62/-123.448	332	738	469	1
Route Complex	40.64/-123.586	345	1,472	2,676	8
River Complex	40.91/-123.437	345	2,333	2,086	6
Nickowitz	41.47/-123.750	396	403	360	1
Gasquet Complex	41.85/-123.969	436	6,640	5,938	14
Total			13,280	14,528	
Oregon/					
Canyon Creek	44.28/-118.96	561	4,463	3,233	6
Washington/					
Kettle	48.76/-118.461	1,066	166	120	<1
Grizzly Bear	46.11/-117.679	814	4,000	7,255	9
Okanogan	48.519/-119.662	1,038	1,856	27	<1

Table 3.4: Q/D Calculations for Thursday, August 20, 2015

Fire Location/ Name	Lat/Long	Distance (km)	Acres Burned	Emissions (tons)	Q/D (tpd/km)
NW California/					
Fork Complex	40.45/-123.128	301	1,120	650	2
Mad River Complex	40.34/-123.383	317	3,622	6,015	19
South Complex	40.62/-123.448	332	400	168	1
Route Complex	40.64/-123.586	345	1,391	2,310	7
River Complex	40.91/-123.437	345	2,532	2,264	7
Nickowitz	41.47/-123.750	396	535	478	1
Gasquet Complex	41.85/-123.969	436	2,463	2,202	5
Total			12,063	14,087	
Oregon/					
Canyon Creek	44.28/-118.96	561	5,675	4,111	7
Washington/					
Kettle	48.76/-118.461	1,066	5,983	4,335	4
Grizzly Bear	46.11/-117.679	814	2,000	3,628	4
Okanogan	48.519/-119.662	1,038	6,463	94	<1

Table 3.5: Q/D Calculations for Friday, August 21, 2015

Fire Location/ Name	Lat/Long	Distance (km)	Acres Burned	Emissions (tons)	Q/D (tpd/km)
NW California/					
Fork Complex	40.45/-123.128	301	188	119	<1
Mad River Complex	40.34/-123.383	317	1,106	2,011	6
South Complex	40.62/-123.448	332	810	514	2
Route Complex	40.64/-123.586	345	193	351	1
River Complex	40.91/-123.437	345	2,415	2,106	6
Nickowitz	41.47/-123.750	396	952	851	2
Gasquet Complex	41.85/-123.969	436	1,864	1,667	4
Total			7,528	7,673	
Oregon/					
Canyon Creek	44.28/-118.96	561	7,755	5,618	10
Washington/					
Kettle	48.76/-118.461	1,066	1,842	1,335	1
Grizzly Bear	46.11/-117.679	814	36,000	65,296	80
Okanogan	48.519/-119.662	1,038	0	0	0

As stated in the 2015 EE Demonstration, Q/D is an equation to estimate fire emissions. It does not account for the cumulative impact of numerous fires producing smoke for multiple days with poor dispersion. This wildfire O<sub>3</sub> episode also supports research that O<sub>3</sub> production can increase with distance (and plume age) from wildfires.



## Key Factor #2

A comparison of the event related O<sub>3</sub> concentration with non-event related high O<sub>3</sub> concentrations is required to satisfy the key factor #2 in a Tier 2 demonstration. Refer to Section 2.4 and 3.2 for event related O<sub>3</sub> concentration with non-event related highs and historical O<sub>3</sub> concentrations.

### 3.4 Additional Tier 2 Evidence

Refer to the 2015 EE Demonstration.

## Trajectory Analysis

Refer to the 2015 EE Demonstration for HYSPLIT description. The following subsections of this addendum provide evidence that the emissions from the Pacific Northwest wildfires affected the Reno3 monitor on August 18 and 19, 2015.

The following figures show the 72-hour backward HYSPLIT trajectories and smoke plumes ending on August 18 and 19, 2015. The maps include 72-hour backward trajectories at three different heights (500, 1000 and 1500 meters) ending at the Reno3 monitoring site with the smoke plume for each day. The backward trajectories demonstrate that the dense smoke plume from August 15 and 16, 2015 traveled across the Pacific Northwest, exacerbating PM<sub>2.5</sub> concentrations leading to an increase in O<sub>3</sub> concentrations in Washoe County on August 18 and 19, 2015. The trajectory profiles identify that the dense smoke plume from the several wildfires throughout the Pacific Northwest traveled along the lower regions of the valley on August 15 and 16, 2015 and settled into the Reno/Sparks area on August 18 and 19, 2015, elevating O<sub>3</sub> concentrations monitored at the Reno3 during the exceptional event. Accompanying the trajectories are area forecast discussions from the National Weather Service (Reno Forecast Office).

Additional Tier 2 Evidence for August 18, 2015

Figure 3.5: 72-Hour Backward HYSPLIT Trajectory and Smoke Plume August 18, 2015

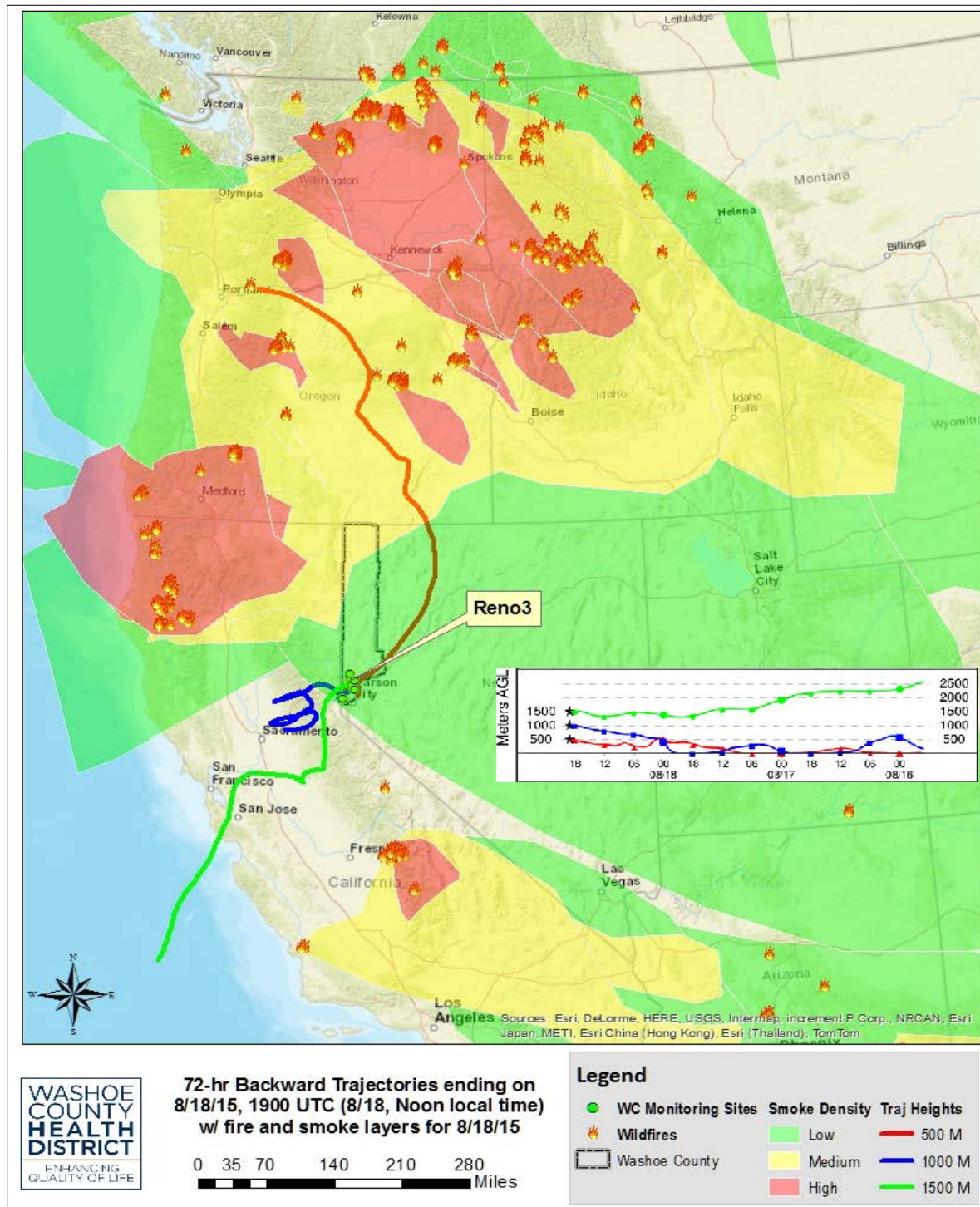


Figure 3.6: National Weather Service (Reno) Area Forecast Discussion for August 18, 2015

### National Weather Service Raw Text Product

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[← Previous in Time](#)[View All KREV Products for 18 Aug 2015](#)[Next in Time →](#)[Latest Product](#)[View As Image](#)

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AFDREV

AREA FORECAST DISCUSSION  
NATIONAL WEATHER SERVICE RENO NV  
130 PM PDT TUE AUG 18 2015

.SYNOPSIS...  
DRY WEATHER WILL CONTINUE THIS WEEK AS HIGH PRESSURE REMAINS IN CONTROL. WHILE A FEW LOCATIONS IN THE SIERRA AND WESTERN NEVADA MAY SET NEW RECORD HIGHS TUESDAY AND WEDNESDAY, NIGHTTIME LOWS WILL BE COOL AND SEASONABLE. AFTERNOON ZEPHYR BREEZES WILL START AGAIN WEDNESDAY. HAZE MAY CONTINUE ACROSS THE AREA INTO SATURDAY AS NORTHWEST WINDS ALOFT WILL BRING SMOKE FROM THE FIRES IN CALIFORNIA, OREGON AND WASHINGTON.



Additional Tier 2 Evidence for August 19, 2015

Figure 3.7: 72-Hour Backward HYSPLIT Trajectory and Smoke Plume August 19, 2015

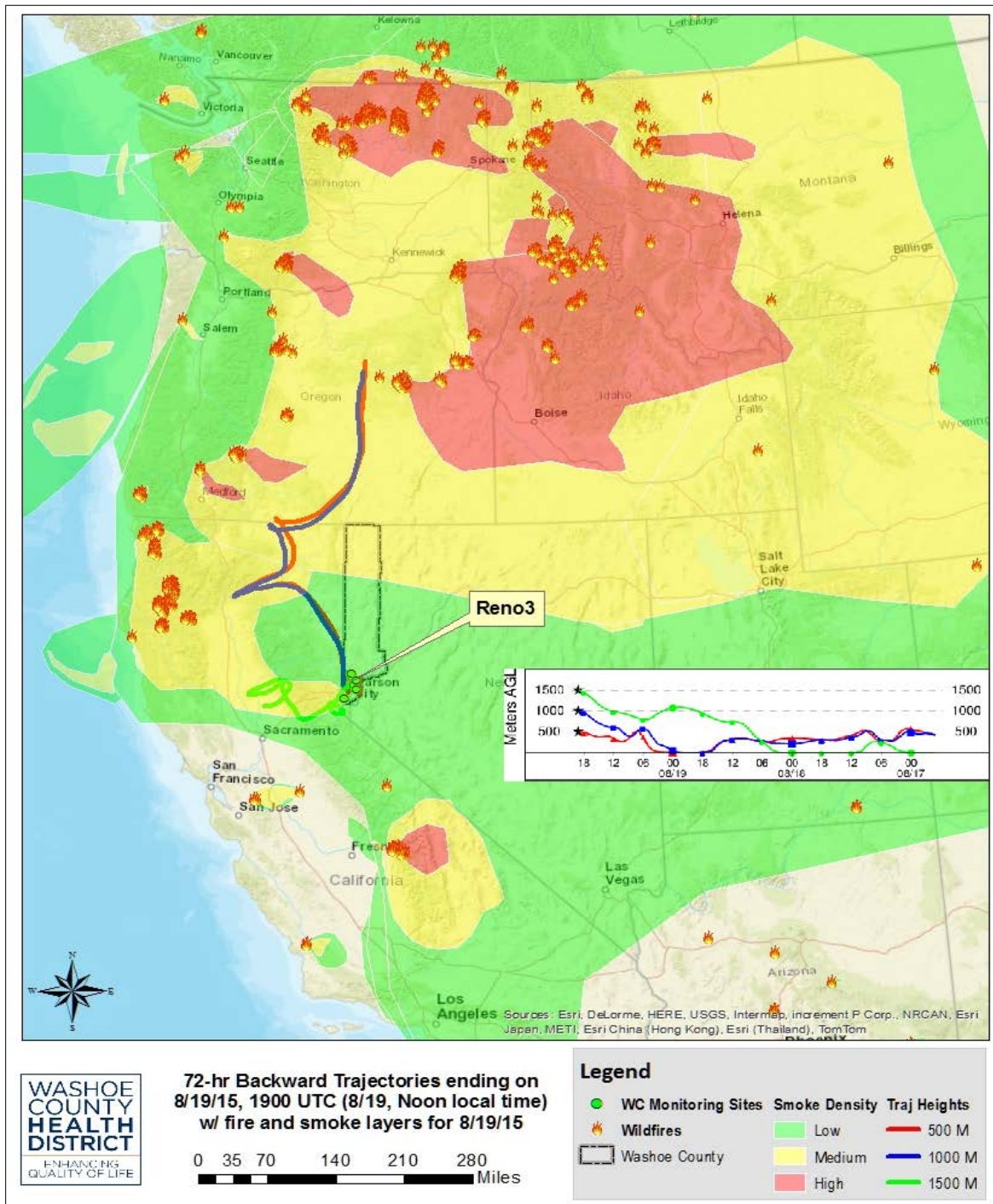


Figure 3.8: National Weather Service (Reno) Area Forecast Discussion for August 19, 2015

### National Weather Service Raw Text Product

Displaying AFOS PIL: AFDREV Received: 2015-08-19 21:58 UTC

[← Previous in Time](#)[View All KREV Products for 19 Aug 2015](#)[Next in Time →](#)[Latest Product](#)[View As Image](#)

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350  
FXUS65 KREV 192158  
AFDREV

AREA FORECAST DISCUSSION  
NATIONAL WEATHER SERVICE RENO NV  
258 PM PDT WED AUG 19 2015

.SYNOPSIS...

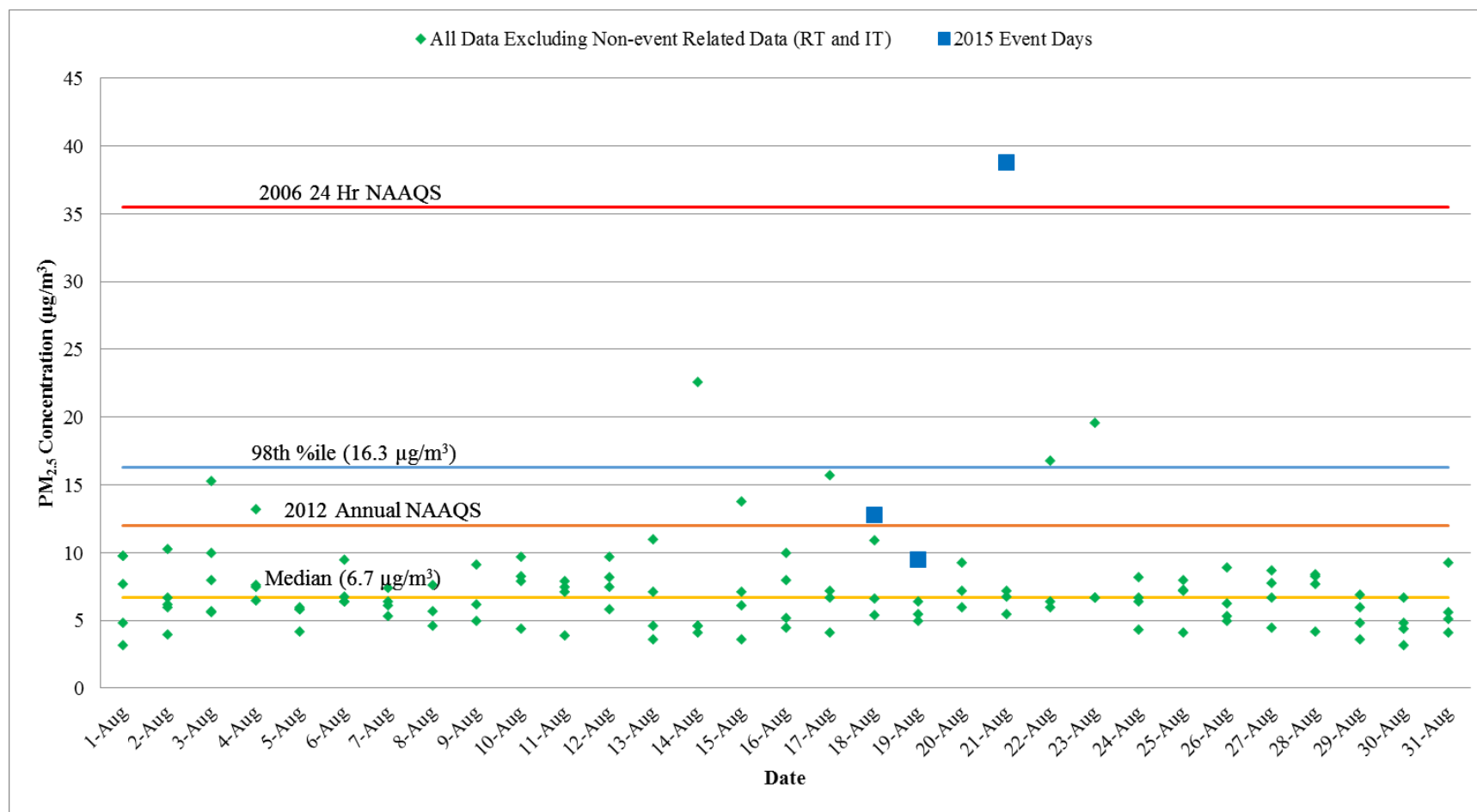
HOT AND DRY CONDITIONS CONTINUE THURSDAY WITH A FEW DEGREES OF COOLING TO START THE WEEKEND. NIGHTTIME LOWS WILL REMAIN COOL AND SEASONABLE. AFTERNOON ZEPHYR BREEZES ARE EXPECTED THIS WEEK AND HAZE FROM THE WILDFIRES IN CALIFORNIA, OREGON AND WASHINGTON MAY CONTINUE OVER THE NEXT SEVERAL DAYS.

### Concentrations of Supporting Measurements

Figure 3.9 shows the elevated level of the 24-hour PM<sub>2.5</sub> average on August 18, 19, and 21, 2015 (indicated by the blue squares) as compared to 5-year historical concentrations. PM<sub>2.5</sub> data in Figure 3.9 does not include data from the 2013 (Rim and American Fires) Exceptional Event Demonstration submitted to the EPA in November 2016.



Figure 3.9: Reno3 24-Hour PM<sub>2.5</sub> Averages for August 2011-2015



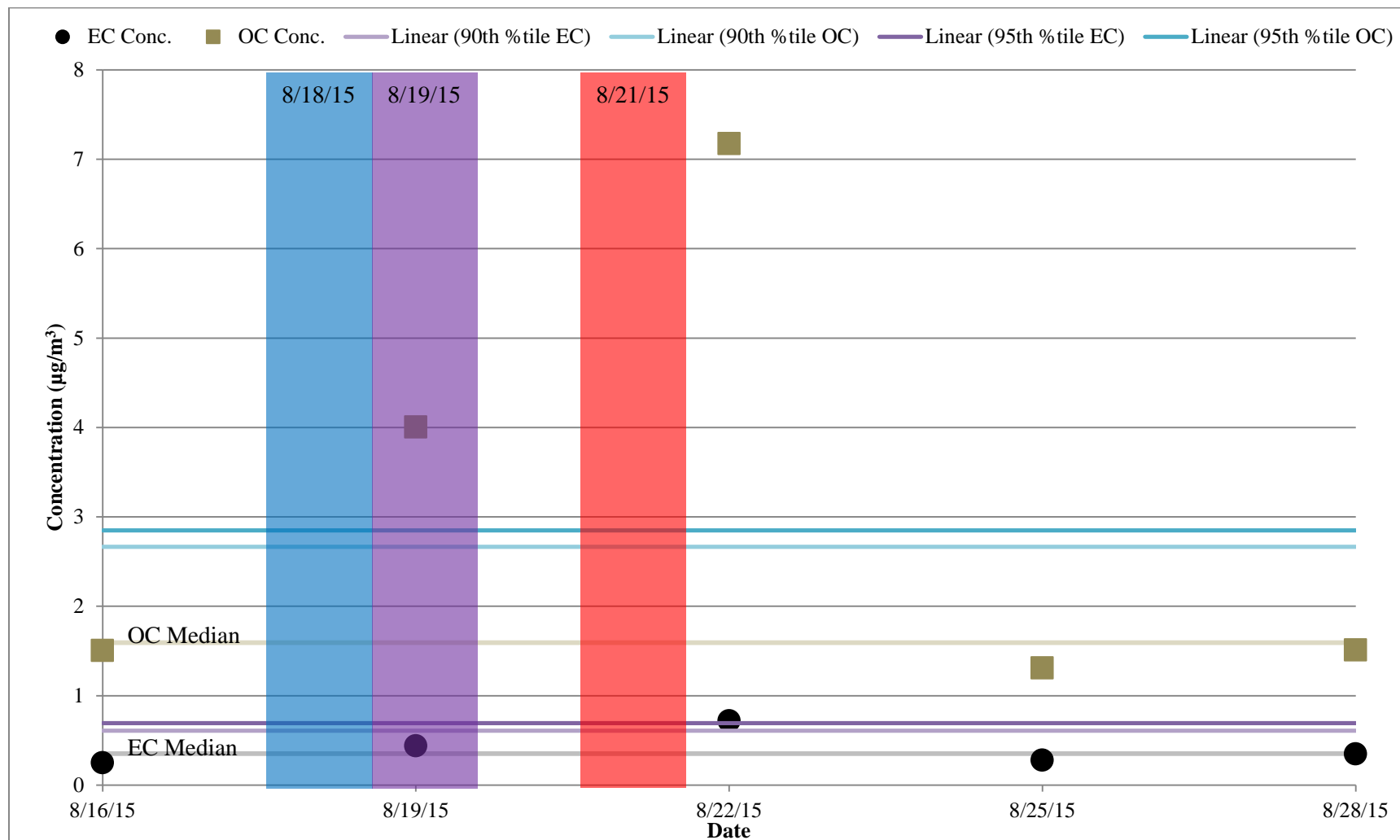
### PM<sub>2.5</sub> Speciation Data

Refer to the 2015 EE Demonstration for detailed information on the Speciation Trends Network as well as historical concentrations of OC and EC from 2010 to 2014. The PM<sub>2.5</sub> Speciation monitor follows EPA's sampling calendar that scheduled two samples during the event (August 19 and 22, 2015).

The historical (Jun-Aug, 2010-2014) median OC concentration is 1.61 µg/m<sup>3</sup>. During the 2015 wildfires, the OC concentration recorded on August 19 (4.00 µg/m<sup>3</sup>) and August 22 (7.17 µg/m<sup>3</sup>) were both above the 95<sup>th</sup> percentile compared to historical concentrations.

Likewise, EC concentrations were also elevated above the 90<sup>th</sup> percentile on August 19 (0.44 µg/m<sup>3</sup>) and August 22 (0.69 µg/m<sup>3</sup>). These are in comparison to the historical median concentration of 0.36 µg/m<sup>3</sup>. Figure 3.10 depicts August 16-28, 2015 concentrations in comparison to historical OC and EC concentrations. Historical concentrations do not include data from the 2013 Rim and American Fires

Figure 3.10: Elemental and Organic Carbon Concentrations during the 2015 Wildfires



### PM<sub>2.5</sub> and Carbon Monoxide Correlation

It has been documented that ambient PM<sub>2.5</sub> and CO concentrations are correlated in the presence of wildfire smoke and as presented at the EPA/WESTAR Exceptional Events Workshop in November 2016 in Denver, CO. PM<sub>2.5</sub> and CO at the Reno3 monitoring site were plotted for August 18, 19, and 21, 2015 and compared to a non-event day (Equation below).

Non-Event Slope (August 24, 2015)

$$y = 4.5986x + 2.5884 \quad R^2 = 0.0014$$

Figure 3.11: Hourly Reno3 PM<sub>2.5</sub> and CO for August 18, 2015

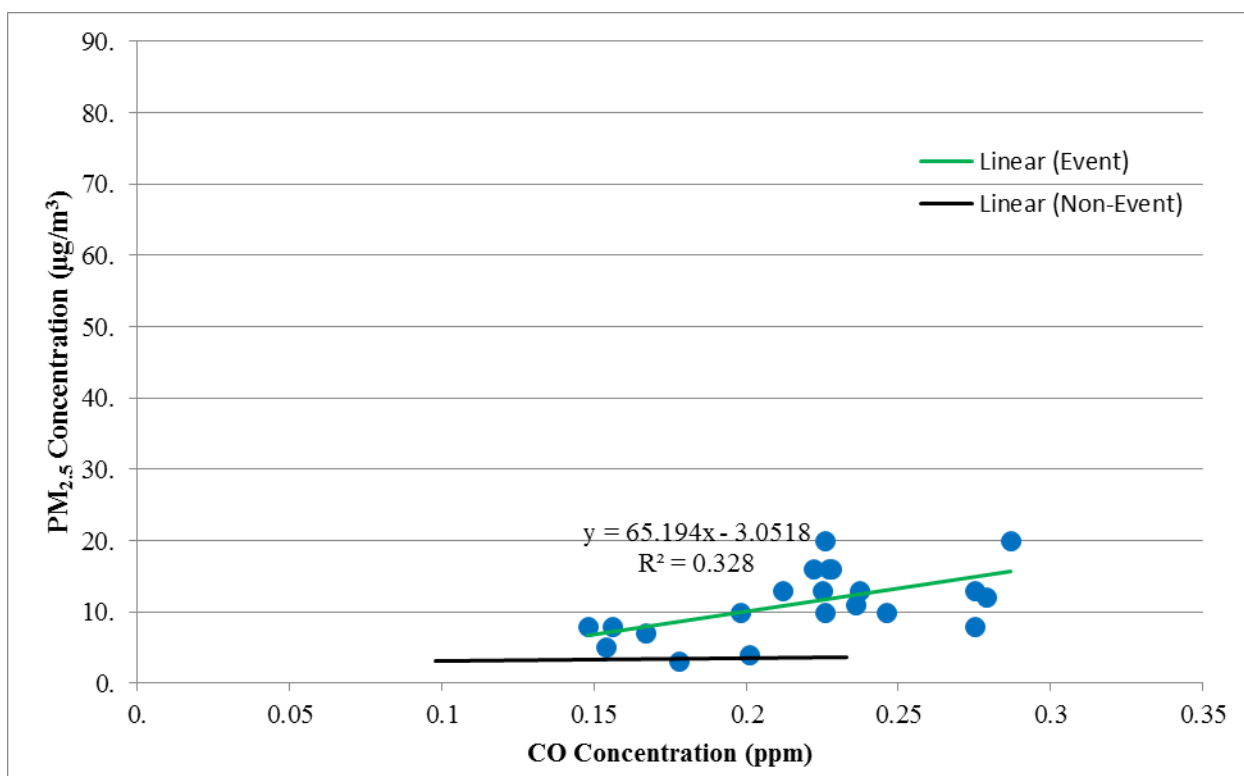




Figure 3.12: Hourly Reno3 PM<sub>2.5</sub> and CO for August 19, 2015

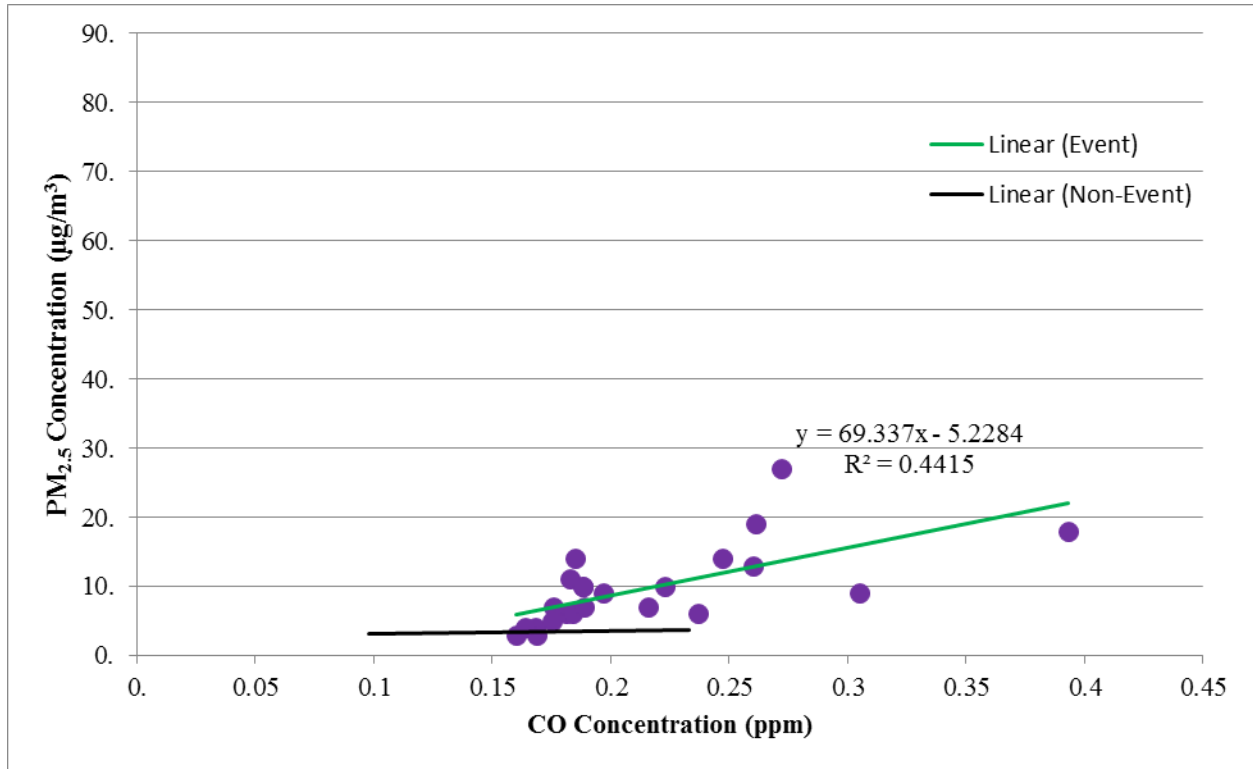
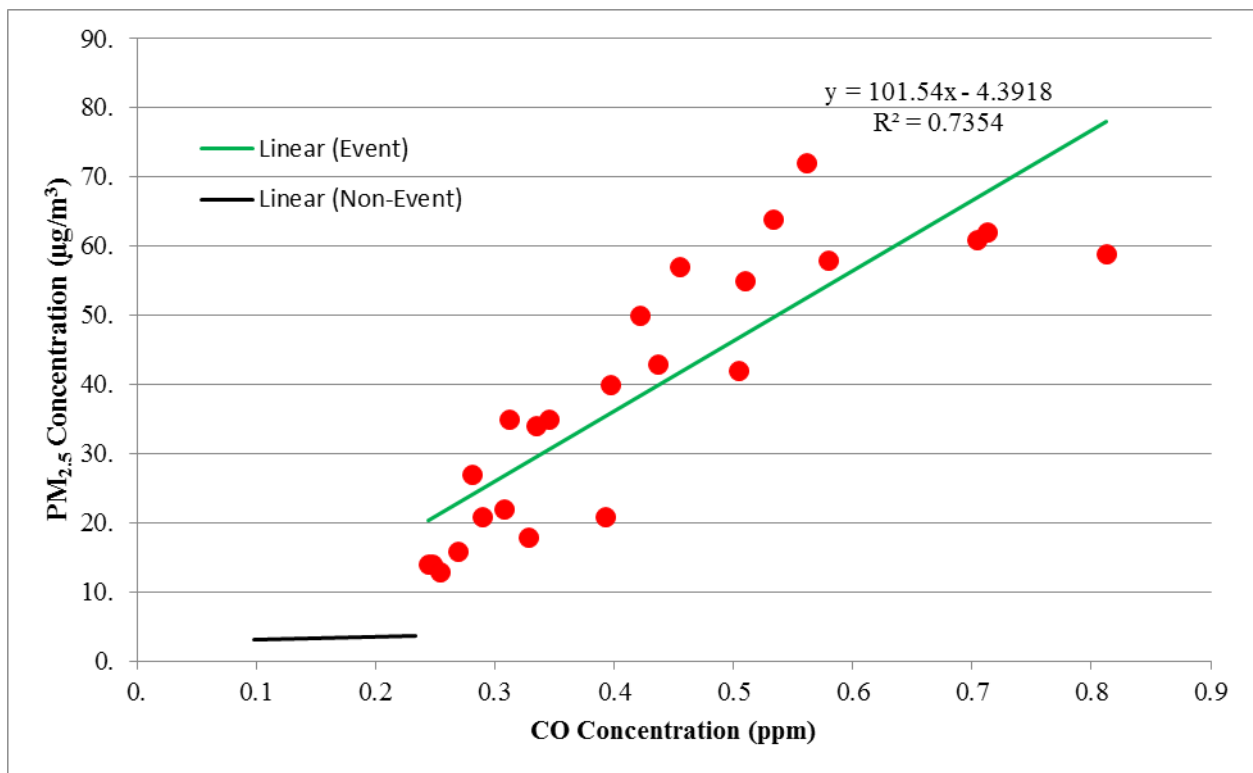


Figure 3.13: Hourly Reno3 PM<sub>2.5</sub> and CO for August 21, 2015



### 3.5 Clear Causal Relationship Conclusion

In August 2015, numerous wildfires in Northwest California, Oregon, and Washington burned tens of thousands of acres. Wildfire smoke, including O<sub>3</sub> precursors, from these fires was transported into the Reno/Sparks area beginning August 17. The Reno/Sparks area, specifically the Reno3 monitor (AQS ID 32-031-0016), measured elevated concentrations of O<sub>3</sub>, PM<sub>2.5</sub>, NO<sub>x</sub>, CO, OC, and EC. The most critical parameters demonstrating wildfire smoke and O<sub>3</sub> (O<sub>3</sub>, OC, and EC) were in the 90<sup>th</sup> to 100<sup>th</sup> percentiles compared to historical concentrations (June-August, 2010-2014). Below is a summary of these critical parameters from the Reno3 station during the days recommended to be excluded (August 18, 19, and 21, 2015) from comparison to the O<sub>3</sub> NAAQS.

Parameter	Percentiles Compared to Historical Concentrations (Jun-Aug, 2010-2014)		
	8/18	8/19	8/21
O <sub>3</sub>	99 <sup>th</sup>	99 <sup>th</sup>	99 <sup>th</sup>
OC	95 <sup>th</sup>	95 <sup>th</sup>	95 <sup>th</sup>
EC	90 <sup>th</sup>	90 <sup>th</sup>	90 <sup>th</sup>

Hourly O<sub>3</sub> concentrations during this period were also unusually high compared to historical concentrations further supporting the presence of wildfire smoke. Additional evidence of the exceptional event is documented with PM<sub>2.5</sub> to CO correlations, HYPSLIT backward trajectories, visible satellite imagery, detected smoke layers, AirNow Tech images, Satellite Smoke Text products, NWS Area Forecast Discussions, and social media posts.

The comparisons and statistical analyses provided in Section 3.0 of this addendum support AQMD's demonstration that the wildfire event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedances on August 18 and 19, 2015. Section 3.0 thus satisfies the clear causal relationship criterion as required by the EER and 40 CFR 50.14(c)(3)(iv). This addendum further supports the August 21, 2015 exceptional event demonstrated in the 2015 EE Demonstration.

#### **4.0 NATURAL EVENT**

Based on the documentation provided in Section 2.0 of this addendum, the event qualifies as a wildfire because lightning caused dozens of unplanned wildfire events throughout the Pacific Northwest. The EPA generally considers the emissions of O<sub>3</sub> precursors from wildfires on wildland to meet the regulatory definition of a natural event at 40 CFR 50.1(k), defined as one “in which human activity plays little or no direct causal role.” These wildfire events occurred on wildland, as documented in Section 2.0, due to lightning, and accordingly, AQMD has demonstrated that the event is a natural event and may be considered for treatment as an exceptional event. Additionally, as demonstrated in Section 2.0 by location maps of the wildfires, the wildfire events were on wildlands occurring on Federal or State owned lands.

## **5.0 NOT REASONABLY CONTROLLABLE OR PREVENTABLE**

Based on the documentation provided in Section 2.0 of this addendum, lightning caused the wildfire events on wildland. The AQMD is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable. Therefore, emissions from this wildfire were not reasonably controllable or preventable.



## 6.0 CONCLUSION AND RECOMMENDATIONS

In August 2015, smoke from numerous wildfires in California, Oregon, and Washington transported into the Reno/Sparks, Nevada area. This resulted in elevated O<sub>3</sub> and PM<sub>2.5</sub> concentrations on August 18-21, 2015. The 2015 EE Demonstration and this addendum support the criteria for an exceptional event detailed in the 2016 Exceptional Events Rule and 2016 Wildfire Ozone Guidance. Specifically, the documentation used the following evidence to demonstrate the exceptional event.

- ambient air monitoring data
- statistical analyses of the monitoring data compared to historical concentrations
- analyses of wildfire smoke emissions
- satellite imagery (visible and detected smoke)
- narratives from the National Oceanic and Atmospheric Administration and National Weather Service (Reno)
- HYSPLIT trajectory analyses
- social and traditional media posts

This addendum, in conjunction with the 2015 EE Demonstration clearly demonstrate the justification of the exclusion of data from August 18, 19, and 21 due to an exceptional event under 40 CFR 50.14(c)(3)(iv). The addendum and demonstration has provided evidence that:

1. Emissions from a wildfire event caused O<sub>3</sub> exceedances at the Reno3 monitor;
2. The event affected air quality in such a way that there exists a clear causal relationship between the event and the exceedances on August 18, 19, and 21, 2015;
3. Event-influenced concentrations were above normal historical concentrations;
4. The event was a lightning caused wildfire on wildland, and therefore a natural event;
5. The event was lightning caused, and therefore not reasonably controllable or preventable.

The AQMD recommends that EPA Region 9 concur with the 2015 EE Demonstration and addendum and exclude data from the Reno3 O<sub>3</sub> monitor for August 18, 19, and 21, 2015 from comparison to the NAAQS.